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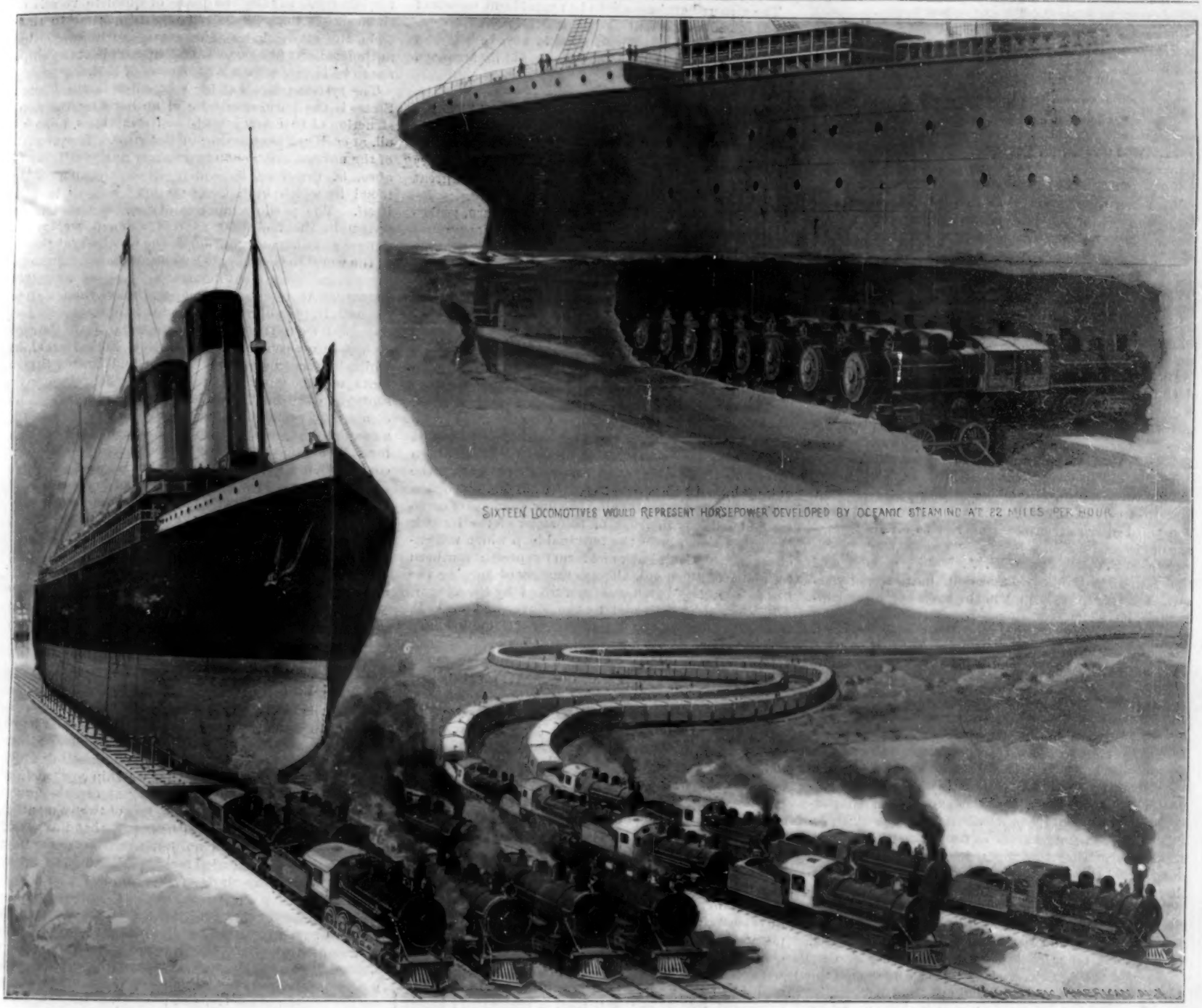

Eight locomotives would haul "Oceanic" on the level at 22 miles per hour. Weight of "Oceanic" represented by two trains, each of 433 cars and 3 miles in length.

Powerful Rogers' Consolidation for the Illinois Central Railroad.

THE HORSE POWER OF AN OCEAN LINER AND A LOCOMOTIVE COMPARED.—[See page 199.]

Scientific American.

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NEW YORK, SATURDAY, MARCH 31, 1900.

THE ISTHMIAN CANAL SURVEY.

We recently had occasion to protest against the Hepburn bill for the immediate construction of the Nicaragua Canal on the ground that it was stupid and unfair to the President and to the Commission to bring in such a measure before the President's Isthmian Canal Commission, which has been appointed for the purpose of determining which was the best possible route across the Isthmus, had had time to complete its labors and present its report. On more than one occasion we have drawn attention to the fact that the obviously proper thing to do before undertaking any active construction, is to make certain that the location selected is, all things considered, the best that can be chosen. In the first place, it is by no means clear that Nicaragua offers a better route than Panama; indeed the balance of evidence thus far adduced would seem to prove the contrary. Moreover, it is quite possible, as we have frequently pointed out, that careful investigation would show that there is a third alternative route superior to either Panama or Nicaragua.

General P. C. Hains and W. A. Noble, members of the Isthmian Canal Commission, have recently returned to this country, and in the course of a press interview, have made certain unofficial statements which would seem fully to justify even to particulars, the attitude taken by the SCIENTIFIC AMERICAN with reference to the Hepburn bill. The investigations of the commission, we are told, have shown that the underlying strata of the site of the big Ochoa Dam, on the Nicaragua Canal, are not so satisfactory as was at first reported, and though it is still considered practicable to build a reliable dam at that place, it is evident that the cost would be greater than estimated by previous commissions. While the route of the Walker Commission is pronounced feasible, the expectation that serious difficulties would be encountered in the construction of a satisfactory harbor at Greytown is confirmed. Mr. Noble stating that a big jetty would have to be constructed through the shifting sands, and that continual dredging would be necessary to keep the channel clear. Mr. Noble seems to have fully endorsed the statements made by the Panama Canal delegation in the preliminary hearing last year at Washington. The general tenor of Mr. Noble's remarks is to the effect that the American Commission found that this canal company was doing, and apparently is capable of accomplishing everything that it has promised. Particularly significant is the fact that our commission found that the Panama Company had a feasible scheme for controlling the Chagres River, a feat which all the world has considered impossible of execution.

The most significant statement of all, however, is that which refers to the possibility of finding a third alternative route across the Isthmus. Mr. Noble is reported as saying that what is known as the Atrate location presents a "good route, perhaps the best route, feasible and short" and in his opinion, "less expensive to build."

Athough the remarks of the returned members of the Commission were entirely unofficial, and were accompanied with the statement that no report of any kind had yet been made, they furnish much food for thought; and we respectfully commend them to the consideration of those members of Congress, who would rush the country into the immediate construction of a particular canal before they know whether it is the cheapest and best that could be built.

THE DESIGNS OF LAST YEAR'S BATTLESHIPS AND CRUISERS.

The hoped for removal of the deadlock occasioned by the refusal of the last Congress to authorize the armor for the new battleships and cruisers authorized at the last session, has encouraged the Construction Department to proceed with the details of the designs. It is stated by a member of the Construction Board that the battleships will be about 13,500 displacement and 18 knots speed. The main battery will consist of four 12-inch guns in two turrets, one forward and one aft, and four 8-inch guns in two turrets located upon either beam and sufficiently to the rear of the forward 12-inch turrets to escape interference. There will also be fourteen 6-inch rapid-firers carried in broadside. This is an extremely formidable battery, far more powerful than is carried by any existing ship in the world today. The decision with regard to the location of the 8 inch gun is not absolutely final, however, for should the forthcoming gunnery trials of the "Kearsarge" prove to be satisfactory, it is possible that the 8-inch guns will be placed above the 12-inch on the double-turret system.

The armored cruisers are to be magnificent vessels of 14,500 tons displacement and 22 knots speed, the battery consisting of four 8-inch guns in two turrets and an unusually large number of 6-inch rapid-firers carried in broadside.

BREAKING GROUND FOR THE RAPID TRANSIT TUNNEL.

Among the red letter days in the history of New York City, Saturday, March 24, 1900, must ever hold an honorable position as having witnessed the ceremonies inaugurating the actual construction of the great underground Rapid Transit Railroad.

Never has any great city, ancient or modern, undertaken a work of improvement which in its present scope and future possibilities could compare with the vast underground transportation system which is thus begun. Great, in the aggregate, as are the various tunnel roads of London, they have been built as separate and unrelated units, and they have taken many decades to reach their present importance; whereas, the system now commenced in this city has been designed as a single system to meet the carefully considered needs of the city. Having exhausted the possibilities of above-ground transportation, New York, which, by reasons of its peculiar topographical situation, has the most complex and difficult transportation problem to deal with of any in the world, has been driven to the underground system as presenting the only practical and adequate relief from its difficulties.

The spot chosen for turning the first spadeful of earth was immediately in front of the steps of the historic City Hall and above the terminal loop which will encircle the City Hall Park and form the present southern terminus of the road. The ceremony of turning the first spadeful of earth was performed by the Mayor. Addresses were delivered by the Mayor and by A. E. Orr, President of the Rapid Transit Commission, a gentleman to whose indefatigable efforts the present successful issue of the labors of the Commission is largely due. The spot will be indicated to future generations by a plain, bronze tablet, set in position not far from the spot where in July, 1776, the Declaration of Independence was read to the American troops in the presence of General Washington. The tablet will contain the names of the Mayor, the Rapid Transit Commissioners, the Chief Engineer, William Barclay Parsons, the contractor, John B. McDonald, and August P. Belmont, the President of the Rapid Transit Subway Construction Company.

The inaugural ceremonies have a special interest for the SCIENTIFIC AMERICAN, in view of the fact that this month exactly thirty years ago saw the opening of an underground tunnel beneath Broadway, which in some respects anticipated the great work which is now to be undertaken. It is well known to our readers that the late Alfred Ely Beach was early impressed with the advantages of underground transit, and had such faith in the possibilities of the system that he organized a company and built a preliminary length of tunnel which by a curious coincidence lies within a stone's throw of the scene of the present ceremonies.

GERMANY'S NAVAL PROGRAMME—A LESSON FOR THE UNITED STATES.

Whatever may be said of the policy of the present Emperor of Germany in general, it must be universally admitted, that as it effects the interests of the navy and merchant marine, it is farsighted and successful. Of the many momentous problems which the young Kaiser found confronting him on his accession to the throne, there is none to which he has addressed himself with greater zeal than to that of raising Germany to a high position in the strength of its merchant marine and in the numbers and efficiency of its navy. At his accession he found a navy which was only less obsolete than was our own in the year 1883, when we commenced the construction of modern steel vessels and for the first few years of his reign new ships were added to the German fleets in the haphazard methods which were characteristic of the naval growth in that era, and, unhappily, still characterize the provisions for increasing our own navy to-day.

In the year 1898, chiefly through the exertions of the Emperor, Germany inaugurated a system of warship construction which bids fair to become general among the navies of the world. Realizing the great length of time which must intervene between the voting of funds for construction and the actual completion or a warship, and probably being desirous of placing the question of the provision of necessary new ships beyond the accidents of party politics, the Government passed, in the year 1898, what was known as the naval septennate programme. This bill provided for the construction of what was practically a new navy, the cost of which was to be spread over a period of seven years, although a final modification limited the period to six years. In addition to new torpedo boats and gunboats, the bill provided for the raising of the strength of the navy by the year 1904, to that of seventeen battleships, eight coast defense vessels, nine large cruisers, and twenty-six small cruisers. The new construction involved called for seven new battle ships, two large, and seven small cruisers, besides new gunboats and torpedo boats to take the place of obsolete vessels of these classes that will be removed from time to time from the active list. The total expenditure thus authorized was $103,000,000, and the whole of the ships are to be in commission by the close of 1904.

The system providing for new ships in the United States is the antiquated one of authorizing the construction of so many vessels and sometimes none at all, at each annual meeting of Congress. The growth of the navy, a matter of the highest national importance, is, therefore, dependent upon the particular mood in which each Congress may happen to find itself. The perilous uncertainty of the system is shown in the fact that at this moment we are in danger of losing our position as the third naval power in the world to Germany, whose septennate programme gives her at the present moment a long lead over this country. An interesting comparison of the relative strength in 1904, of our navy and that of Germany, has appeared from the pen of Commander J. D. Jerrold Kelley in a recent issue of The New York Herald, in which it is shown that the German and United States fleets will be approximately equal when Germany's septennate scheme is completed in the year 1904. The comparison would be more gratifying were it not for a couple of important "ifs" with which it is prefaced, for it is assumed that Congress will agree to the new construction recommended by the House Committee and commented upon in our issue of last week, and that these ships and the battleships and cruisers of the "New Jersey" and the "California" classes, authorized last year, will be completed by 1904.

As a matter of fact, however, the ships of the latter class are at present held up for want of the necessary armor, and the ships of this year's programme may yet fall a victim, like those of last year, to the political exigencies of Congress. Unless the present Congress take favorable action, the year 1904 will find the German navy preponderating over our own to the extent of six first-class battleships and three large cruisers, representing together an advantage of no less than 110,000 tons in armored ships. A comparison of the number of vessels shows that Germany would possess nineteen first-class battleships against our twelve, and twelve large cruisers against our nine. And it must be remembered that warship construction is so long-drawn-out, that no amount of subsequent energy could compensate for the loss of tweive months' time thus incurred. It is to be hoped that in view of these facts Congress will not fail to authorize the new construction recommended for this year, and the necessary armor for the ships of this and last year's programmes.

So much for the year 1904. What of the years that follow it? Germany is so well satisfied with the septennate scheme that the Emperor has had the farsightedness and courage to have prepared another and much more ambitious programme, which will provide for the growth of the German navy up to the year 1920. The number of battleships contemplated for 1904 is to be doubled by the addition of nineteen new ships, giving a total of thirty-eight, while the navy is to include at that date twenty large cruisers and forty-five protected cruisers, the new ships thus provided for having a total displacement of 400,000 tons. Not only is the continuity of the construction work ensured for two decades, but adequate provision is made for the construction of the necessary docks and harbors. The total cost of this construction will be $465,250,000 which is to be raised by a scheme of loans and revenue taxes.

The question naturally arises if we are in danger of falling so far behind Germany by the year 1900, where shall we stand at the close of the year 1920? To leave such an important matter as the authorization of the new warships to the caprice of the naval committees of each current year, while our competitors, with commendable farsightedness, are establishing programmes that reach two full decades into the future, is to expose ourselves to the danger of being hopelessly outmatched at some future critical period in our foreign relations.

THE STEERING OF MODERN, SCREW-PROPELLED SHIPS.

The statistics of steamship disasters for the year 1898 showed that 42 per cent were caused by strandings alone. Startling as the fact may be to landsmen, shipowners and marine underwriters are well aware of the large ratio of losses due to vessels running ashore, as compared with losses due to collisions, founderings, and other accidents of the sea. After we have eliminated the strandings, known to have been due to fogs

and heavy weather, or to errors of calculation, or to carelessness on the part of the officers in charge, there is left a considerable number of casualities of this kind, of which a satisfactory explanation has never been given, and probably never will be. One of the most recent and significant instances is to be found in the recent loss of the "Mohegan," off the southern coast of England.

The remarkable disparity between the figures representing what we might call deep-sea and shoal water disasters, naturally raises the question as to whether, after we have exhausted the possible and probable causes, or combination of causes, of such an appalling list of strandings, there is not some other and unsuspected force at work against which no amount of care on the part of the navigator can avail. The subject was discussed at considerable length by the late Captain Cornelius W. McKay, in a paper which is published for the first time in the current issue of the SUPPLEMENT. Mr. McKay's explanation of these marine disasters is summed up in the statement, "it is respectfully submitted to the nautical world that the modern twin screw ship does not always sail as she is pointed; in fact, that she cannot." The author argues that the extreme length of the modern merchant steamer renders it extremely difficult properly to control her course by means of a rudder acting at its rear end; and he argues that under certain conditions as, for instance, when wind and sea are acting on the bow and the helm is thrown over to counteract the effect, the resultant motion of the vessel is in a direction which makes a greater or less angle with the line of her keel. It is pointed out that if a modern Atlantic record-breaker should vary in her course only one degree it would have no serious consequence in the navigation of the Atlantic Ocean, but that "one degree more or less might mean something when dusting the whitewash off the lighthouses on the shores of the English Channel in the endeavor to cut time."

While we are not prepared to agree with all of Capt. McKay's conclusions, the subject is worked out in an ingenious and very readable manner, and the article carries weight, as coming from one so well qualified to speak on the subject. The point is well made, that the enormous disparity in casualties from stranding, as compared with those occurring from other causes, may well make us seek for some unsuspected or little understood cause for this class of marine disasters.

THE HEAVENS IN APRIL.

BY HENRY NORRIS RUSSELL, A.M.

The evening skies during April present the greatest number of first magnitude stars visible at any one time during the year. Twelve of the sixteen brightest stars visible in this latitude are above the horizon at once, and the brilliant spectacle which they afford is well supported by their less conspicuous neighbors.

At 9 P. M. in the middle of the month Orion hangs close above the western horizon, the three stars of his belt forming a nearly horizontal line. Above them is the bright red star Betelgeuse, in the giant's right shoulder, and equally far below the White Rigel marks his left foot. Between the belt and Rigel are three fainter stars in an almost vertical row, which form his sword. All three of these appear in a field glass as interesting double stars; and around the middle one spreads the great nebula, one of the most magnificent of telescopic objects.

The line of Orion's belt points on the left to the brilliant Sirius, and on the right to the ruddy Aldebaran, beyond which are the Pleiades. Above Sirius, and forming an almost equilateral triangle with it and Betelgeuse, is Procyon, the lesser dog-star, while farther north above Orion, starry Gemini displays its twin brilliants, Castor and Pollux, and still farther to the right is the bright star Capella, near the Milky Way.

The Great Bear is almost overhead, in the highest part of its circle around the pole. Farther south is Leo, only too well known to those who watched vainly for the meteors of last November, which is marked by the familiar "sickle" with Regulus at the end of the handle. Arcturus shines at a considerable altitude in the eastern sky, while below and to the right the paler Spica marks the constellation Virgo, and far in the northeast Vega is once more above the horizon, after some months' absence from the evening skies.

THE PLANETS.

Mercury is a morning star in Pisces, rising about an hour before the sun at the beginning of the month, and nearly an hour and a half at the close. On the evening of the 21st, it reaches its greatest apparent distance from the sun—about 27°. This is considerably greater than usual, because Mercury is in that part of its eccentric orbit which is farthest from the sun, its greatest distance being reached on the 16th. This circumstance affords a good view of the planet to those early risers who choose to look for it in the morning twilight, but is partly compensated for by its loss of brightness, due to the fact that at its greatest distance from the sun it is exposed to less than half the light and heat which pour upon it when nearest.

Venus dominates the evening sky, remaining above the horizon for fully four hours after sunset, and far surpassing in brightness its stellar neighbors. During the month it traverses the length of Taurus, passing close to the Pleiades on the 5th. It is very bright, continuing to increase in this respect throughout the month and can easily be seen in the daytime with the naked eye, if one knows just where to look for it.

There is really no difficulty at all in seeing Venus (when near its elongation) on any clear day, even at noon. The difficulty consists in finding so small an object without anything to guide the eye to it. When once found the planet is easily seen, and may be shown to others by getting it in line with the top of a tree or any other object which serves as an object guide.

Such a pointer will be furnished by nature on the afternoon of the 2d, when the moon comes close to Venus. The distance is least about 9 P. M., when it is less than twice the moon's diameter. So throughout the afternoon Venus may be seen, weather permitting, above and to the left of the crescent moon, at a distance of three or four of its diameters.

It will be interesting to note the contrast in brightness between Venus and the moon. In spite of its very small apparent size, Venus appears much more luminous than the moon.

This is explained by the two facts that Venus enjoys a sunlight twice as bright as ours, and that it reflects over half the light which falls upon it, while the moon reflects only about one-sixth.

Mars is a morning star in Pisces, but is distant from the earth and faint. It passes close to Mercury on the forenoon of the 2d.

Jupiter is gradually coming into position for evening observation, rising a little before midnight on the 1st and at about 10 P. M. on the 30th. It is in Scorpio, about 5 degrees north of the bright star Antares.

Saturn is a morning star in Sagettarius, rising about 1 A. M. at the beginning of the month and two hours earlier at its close. Its rings are very widely opened out, but it is too far south for favorable observation. Uranus is in Scorpio, quite close to Jupiter, and Neptune in Taurus, but too faint to be seen without a telescope.

THE MOON.

First quarter occurs on the afternoon of the 6th, full moon on that of the 14th, last quarter on the morning of the 22d, and new moon on the night of the 28th.

The moon is nearest to the earth on the morning of the 11th, and most remote on the night of the 26th.

Besides the conjunction with Venus, already mentioned, the moon passes Jupiter (quite closely) on the morning of the 18th; Uranus the same afternoon; Saturn on the morning of the 20th; Mercury on that of the 27th, and Mars the same afternoon.

Princeton University Observatory.

THREE TYPES OF AUTOMOBILES.

At a meeting of the New York Electrical Society, held in this city on the 22d instant, talks by representatives of three different kinds of automobiles was given, accompanied by illustrations, for the purpose of enabling those present to form an opinion as to which was the superior.

The first speaker was Mr. A. L. Riker, the inventor of the Riker Electric Vehicle and Running Gear. He stated that the advantage of electric power was that it was like the horse, in giving a great quantity when needed, easily and quickly. Then he explained three plans for connecting up the storage battery for producing different speeds by using sections of the whole battery and connecting them up in multiple or series, according as a rapid or slow speed was desired.

For pleasure vehicles, from 12 to 15 miles an hour was the fastest speed.

This plan of the subdivision of the battery is more economical than the use of resistance coils in cutting down the current, and has the advantage, in case of a rupture in the high-speed circuit, of enabling the vehicle to be taken home on the remaining cells grouped for the slow speed. Illustrations were shown of the controller operated by a single lever; when moved forward from a zero point the vehicle moved forward, and when moved backward from zero reversed the motor and moved the vehicle backward.

Special devices are provided to lock the lever at the zero point. On the front dashboard is placed the voltmeter and ammeter indicating the condition of the battery when discharging. In a battery of 44 cells the voltmeter should show 80 volts. Starting at this figure the vehicle may be run till the voltage falls to 68 volts, then the battery should be recharged. In going away from home it was well to return when the voltage dropped to 74

The charging plug was shown, and is constructed in such a way as to prevent any mixing of the battery pole terminals. In New York, the Edison Company would soon establish electric hydrants in front of their stations for the purpose of facilitating carriage charging. There were illustrations of storage battery crates showing the plan of burning the lead terminals together, also of the motor, the single and double gear equipments, the double-gear steel frame being very flexible. The differential gear is located in the hub of one of the wheels of the rear axle, on the single-gear frame, which allows a solid steel axle to extend between the two wheels. The gear wheel meshing into the pinion of the motor is supported upon a tubular axle, within which is the solid axle. This construction is much stronger than the old system of having the axle divided and the differential gear located in the center.

The steering gear was explained, also the two plans of applying the brakes and several illustrations of completed vehicles of different styles were shown.

Mr. C. J. Field discussed the "Present Development of the Gasoline Type of Automobile," showing by diagrams the general construction of the four-cycle flanged-jacket motor. He thought the reason why these motor carriages were used abroad more than in the United States was on account of the more general production of electricity here, the facilities for the charging of batteries of electric vehicles being better, but for pleasure touring over long distances he regarded the gasoline-driven vehicles as superior. The four-cycle type of engine was preferred.

Ninety per cent of the difficulties in starting or operating gasoline engines was due to the imperfect electrical construction or insufficient electric power to produce the proper spark. The jump spark and wiping spark are preferable and mostly used. Special flanged cooling tanks are provided, through which the water flows from the water jacket of the engine and is cooled by the air impact. This improvement allows a smaller weight of water to be carried.

The most approved carburetor for heating the vapor gas is called the Areile; heated air surrounds the outlet of the gasoline vapor, mixes with the latter, heats it, and further on is mixed with cold air, then passes on to the engine. The devices for obtaining variable speeds from a constantly running shaft, he stated, were still crude and clumsy.

Some of the hydrocarbon racing machines abroad had engines of 24 horse power, and made records of 35 miles an hour, some going above 40 miles.

He spoke of the Belgium system of combining gasoline and electricity in the same vehicle in connection with a small storage battery which had some promise of value and economy.

Succeeding Mr. Field, Mr. J. A. Kingman reviewed the history of the steam carriage, showing a picture of Cugnot's carriage, invented as early as 1769. Many other steam coaches and stages were shown, until the era of liquid fuel brought the speaker down to the latest improvements of Whitney, a relative of Eli Whitney, the inventor of the cotton gin, and Stanley, known as the locomobile, where the miniature boiler is located under the seat. The pressure carried is 160 pounds to the square inch and steam can be generated within five minutes. The fuel is vaporized and combustion is promoted by compressed air.

After the presentation of the three forms of vehicles there was a brief interesting discussion. The opinion expressed was rather more favorable to the electrical vehicle, one member stating that he did not fancy the idea of sitting over a boiler under a pressure of 160 pounds to the square inch.

MUTUAL AID SOCIETIES FOR FRENCH SCHOOL CHILDREN.

A great many mutual aid societies called "petit-cavés," from their founders, MM. Petit and Cavé, are now being organized among the school children of France. They are established under a law of 1856, and made operative by a law of 1898. The object is to accord assistance to the child members during sickness and to furnish a pension fund for old age. The maximum amount which can be obtained as a pension is only $69.48 per annum. The children deposit 2 cents per week, one cent going to the fund for aid in sickness and the other to the pension fund. This money is placed in the government repository where it is invested in government bonds. The government aids these societies; for every child who contributes during an entire year, the state gives a franc, or nearly 20 cents to the common fund. It also gives a sum equal to the entire amount deposited by the children. The one cent deposited weekly which goes to the pension fund can never be reclaimed except in the form of a pension. The money derived from the reserve fund passes to the next of kin in the event of the death of the depositor. Each child is given a bankbook in which the deposits may be entered and which gives tables and information regarding the plan. The aim of the children's societies is to aid parents by paying them an indemnity during the sickness of their children of 10 cents per day during the first, and five cents per day during the second and third months of their sickness; also to create annual pension funds and to imbue all children at an early age with the element of economy, to accustom them to the use of a bankbook, and to the consciousness of having money at work earning something for them and held in reserve for their old age. The society is spreading rapidly throughout France, specially among the working classes. The savings banks at the present time are being overrun with deposits; the money limit for any one depositor at present is $386, but after August of this year this will be reduced to $289.

A CHEAP TELEPHONE SYSTEM FOR FARMERS.

We have been favored by Mr. Robert E. Maranville, of The Pendleton Republican, Pendleton, Indiana, with particulars of the unique telephone line shown in our illustration, which is now in use between the cities of Anderson, Pendleton, and Ingalls, Indiana. The line, it seems, is not an experiment, but is in active daily operation with four regular subscribers, and it gives a service which our correspondent assures us

HOME-MADE FENCE TELEPHONE SYSTEM.

compares well with the lines of the regular companies. The line is unique in that it employs as a conductor such a common, everyday commodity as the top wire of a barb-wire fence, the continuity of the line being assured by special devices at highway and railroad crossings. It is claimed by its originator and owner, Mr. C. Alley, to be the only one of its kind in existence. The line is 14 miles in length with five stations, two at Anderson, two in Pendleton and one at Ingalls. We are informed that additional subscribers could be served to advantage, but that the terms of the contract with the present parties prohibit it. The unquestioned success of this novel telephone line is stated to be due largely to the perfect insulation. The builder invariably uses the top strand of the fence wire which is treated to a generous coating of rubber paint. At the fence sections common galvanized wire is used to continue the circuit to a connection with the next fence, the same arrangement being carried out at the railroad crossings. In order to carry the line across the road or highway, the circuit is either placed beneath an inverted trough, covered by the material of the road, or as shown in our accompanying illustration it is carried overhead by means of two poles, one on each side of the crossing. In this illustration, Mr. Alley himself is seen in the act of "telephoning to town," a feat which can be performed at any desired point along the line by simply attaching, as shown, a portable transmitter and receiver.

The inventor is very much pleased with the results of his simple and economical system, which, undoubtedly, has many features to recommend itself to rural communities. The cost is extremely low, as there is no expense for copper wires, and poles are only needed at the crossings. Where the number of patrons is not too large, the service is said to be all that could be desired. Our correspondent states that he has used the fence line to converse with a friend some eight miles distant, and this at a time when the fence-posts were still saturated with the morning dew, a condition under which the line is supposed to work to the least satisfaction.

The line has been such a practical success that the farmers of the neighborhood are organizing companies for the purpose of placing themselves in telephonic communication throughout the whole district. As evidence of the practicability of the barb-wire telephone our correspondent quotes the case of the Wagner Glass Company, who, with offices at Anderson, are able to communicate daily with their plant at Ingalls, thirteen miles distant. The cost in this case is only $100 per year, and there is the added advantage that having only two other subscribers on that wire, the line is almost always available.

A NEW METHOD OF CUTTING THREADS.

All machinists know the difficulty of cutting threads on the lathe. The tool must be carefully set by the use of the small thread gage; the point must be frequently sharpened, and the utmost patience, care and skill must be exercised to secure exact duplication. With the invention of a new device by Mr. Herman Dock, of the Rivett-Dock Company, of Brighton, Mass., the difficulties of thread cutting have largely disappeared. The work of the skilled operator is more accurately and more quickly performed by mechanical means.

Mr. Dock's device, as our illustration shows, consists of a steel disk mounted on a slidable holder and provided with teeth on its periphery ground to the exact angle of the thread for which the tool is designed. These teeth are, in truth, cutting tools, each of which has a greater radial length than its predecessor. The disk and its slide can be reciprocated on the vertical supporting frame by means of a hand lever. The heel of the cutting tooth rests on a stop or support on the base block, and thus holds the tooth constantly against the work, preventing all chattering and taking up the strain.

In operation the face of the cutter is squared to the work or axis of the lathe, and the cutting faces are leveled as nearly as possible to the center line of the lathe. The cross slide is run in until the first cutter or tooth engages the work. The first tooth will cut the rough beginning of a V-thread. At the end of a cut the hand lever is swung back, carrying with it the disk and automatically rotating the disk through one tooth by means of a pawl. The lathe is then reversed; the lever is thrown forward to present the second tooth of the disk to the work, and a second, somewhat deeper cut, is made. After each cut the lathe is reversed and a new and finer cutter presented to the work. The last cut cleans up the thread exactly as in the final cut of a single-point tool. There are, hence, nine heavy measured cuts and one final cleaning and finishing cut.

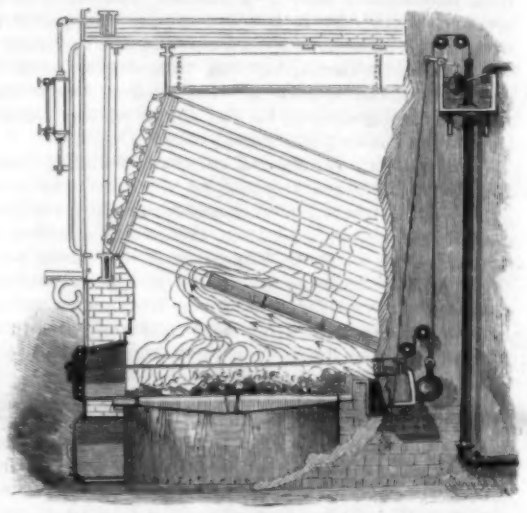
The frame of the tool rests and rocks on a rib directly under the center of the cutting disk. By means of an elevating screw (not shown in the illustration) the tool can be given any rake necessary for a right or left thread.

This new tool enables the lathe to run at double the usual speed to cut threads from three to ten times more quickly than in the old way. A standard 8-pitch thread can be cut in ten cuts on 1-inch machine steel with the lathe running at 135 turns per minute.

AN IMPROVEMENT IN SMOKE CONSUMING FURNACES.

In most smoke-consuming furnaces atmospheric oxygen is admitted in a continuous current to the fire to aid the combustion of the smoke. The smoke and gases may be burnt; but the temperature at times is so considerably reduced that the system is not economical. An invention, operating on a principle radically different from that of such furnaces, has been recently patented by Mr. William C. Johnson, of Memphis, Tenn. The invention in question consists in supplying atmospheric oxygen to the fire not continuously, as heretofore, but only at the time when smoke is produced,—in other words immediately after fresh stoking. The furnace is, therefore, not unnecessarily chilled; the oxygen is fed only when it is required and is then automatically cut off. As even a heavily fired boiler furnace throws off smoke of incomplete combustion about one-half the time the great saving effected here is easily seen.

As our illustration shows, the bridge-wall is formed with a passage designed to conduct atmospheric air to the furnace and closed at its outer end by a door. A cable extends upwardly from this door to a lever carrying a float rising and falling in an ordinary flushing-tank and controlling the water-supply valve. The outlet valve of the tank is connected with the firebox door by a second cable running over idler-pulleys and carrying a weight. When the fire door is closed, the bridge-wall passage door is also closed. But, when in order to stoke the furnace, the fire door is opened, the weight on the second cable drops and the outlet valve in the tank opens. The falling of the water causes the float to descend and the bridge-wall passage door to open, thereby admitting air to the furnace. The closing of the fire door restores the parts to their normal positions, not simultaneously, however, but gradually. For the rising of the water in the tank will require a certain time, during which, the bridge-wall passage door remains open; when the water has reached the normal height, the float will close the bridge-wall passage door. The rising of the water can be regulated so as to cut off the atmospheric oxygen only when the smoke has been entirely consumed, after which the ordinary draft will answer for the needs of the furnace. It is very important for purposes of economy that just the right quantity and no more of atmospheric oxygen should be introduced and

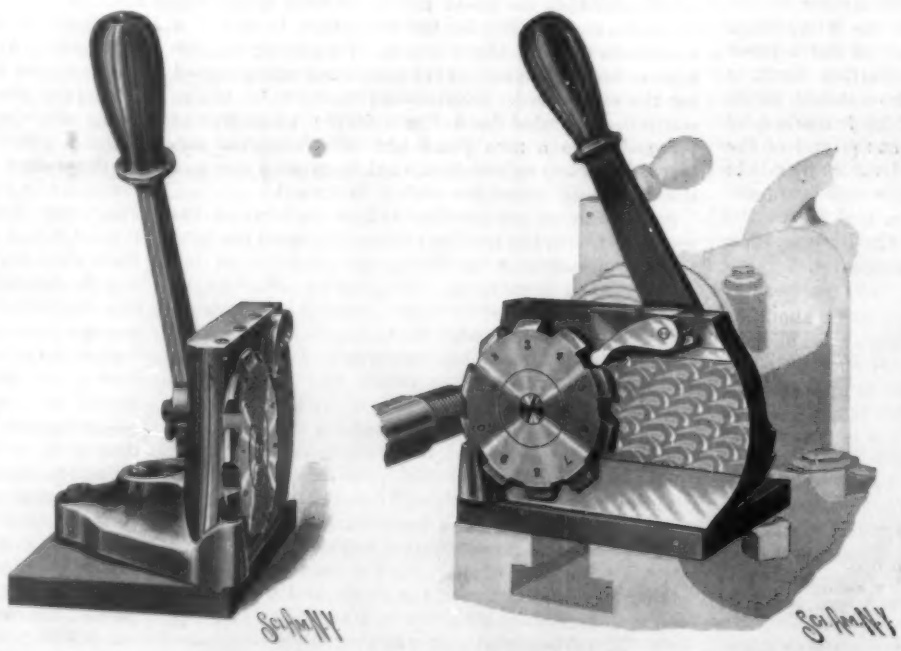


AN IMPROVEMENT IN SMOKE-CONSUMING FURNACES.

this is regulated by the size of opening through door to bridge-wall.

In order to force the atmospheric oxygen into the furnace and distribute it over the fuel, the lower row of pipes are partially covered with fire-brick, forming a deflector. When horizontal tubular boilers are used a number of bends of pipe are arranged at an incline over the grate, which pipes project outside of the furnace. The pipes are fed with water by a feed-water pump and discharged into the boiler. The ends of the pipes are closed by plugs which can be removed to clean the pipes. The upper side of the pipes supports a continuous wall of light fire-brick which serves to deflect the draft through the bridge-wall passage. The fire-brick, as it becomes incandescent, effectually assists the fuel in heating the feed-water and thus serves the double function of heating and deflecting.

The furnace is not untried. The inventor has subjected his device to severe tests and has proven its economy and efficiency. The cost of the water used in the tank will vary with the locality, but has not as yet exceeded 8 cents per day. The saving of fuel, we have been told, is very appreciable. This furnace is inexpensive in construction and is equally applicable, as we have seen, to the horizontal tubular and any of the water tank boilers. With the latter special feed water pipes in the furnace are not necessary.



TWO VIEWS OF AN INGENIOUS MECHANICAL THREAD CUTTER.

THE electric launches on the Grand Canal, Venice, are getting very popular and it looks as though the steamboats were seeing their last days, the great objection to them being their dense smoke, and the large waves produced by them, which are damaging the palaces along the canal. Of course the electric launches are not open to these objections.

A CHEAP AND EFFICIENT TYPEWRITER.

The respect commanded by a typewritten letter, as well as the greater legibility obtained by means of a writing machine, has induced many tradesmen whose correspondence is sufficiently large, to purchase an expensive typewriter. But the cost of the machines commonly used in large offices places them beyond the purse of the average tradesman. The want of a cheap, yet efficient machine, which will perform the service of a more costly typewriter, has been filled by the Simplex Typewriter Company, of 644 First Avenue, New York city, with the introduction of a very simple and ingenious apparatus, which has been patented here and in Europe.

The typewriter in question, as our illustration shows, consists of a table upon which are mounted a type carriage, sliding in guides, a rack, and a roller to feed the paper.

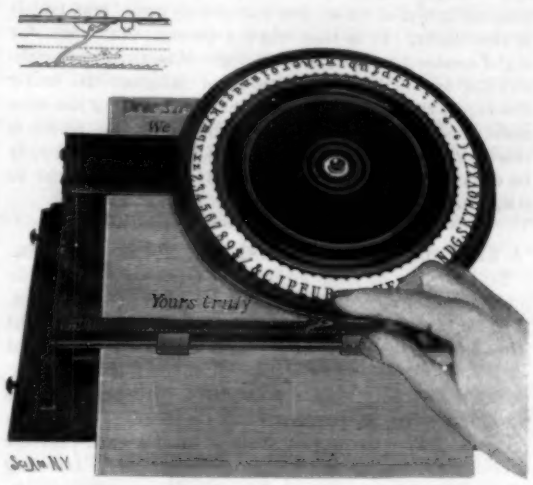
The carriage consists of a base plate upon which is centrally pivoted a printing wheel, provided with rubber keys carried on the ends of radial spring fingers. The type at the lower surface of these spring fingers is inked directly from removable pads, thus dispensing with the cumbersome ribbon.

In operation, the particular key to be used is depressed together with the carriage, and the wheel is rotated to bring the key to the front of the carriage. Here the key falls into a recess into contact with the paper, and is automatically locked during the printing operation.

The elevation of the depressed carriage and the spacing are effected by a very simple automatic device carried on the carriage. The device comprises merely a dog, which engages the rack on the table and which is controlled by a retractile spring. When a key and the carriage are depressed during the printing, the dog engages a rack tooth, forces the carriage to the right, and assumes a nearly horizontal position. When the carriage rises, after the pressure is relieved, the dog, under the action of the retractile spring, shifts forward ready to enter the next tooth when the carriage is again depressed.

Novel features of the invention, besides the new principle of operation, are the automatic spacing and locking mechanisms. The recess in the base plate by which the wheel is locked as a key falls into it, holds the wheel exactly in place during the printing operation. In many typewriters of a somewhat similar nature, no means are provided for arresting the wheel as a key comes into proper position.

The speed of the machine is essentially that of the ordinary typewriter, plus the additional movement required to swing a key to the locking point. It will be seen that the typewriter possesses the essential features of every writing machine; a key for each letter, sight-writing, self-spacing, and roller feed, without the intricacies of the usual mechanism.



AN INEXPENSIVE FORM OF TYPEWRITER.

THE NORTH GERMAN LLOYD LINER "KAISERIN MARIA THERESIA."

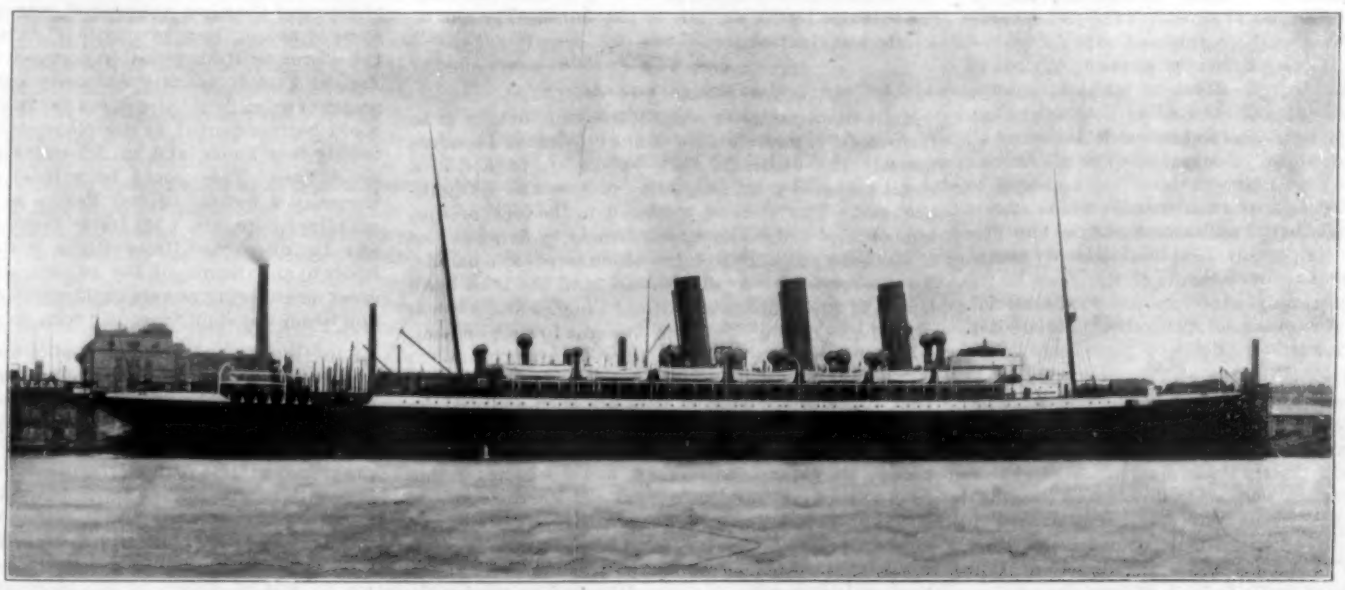
The latest evidence of the activity of the two great German Atlantic transportation companies is the arrival in the port of New York of the handsome North German Lloyd liner which forms the subject of the accompanying engraving. Our readers will remember that in the issue of the SUPPLEMENT of January 7, last year, we published a set of interesting engravings showing the process of lengthening and reconstructing the North German Lloyd liner "Spree." The new "Kaiserin Maria Theresia" is the old "Spree," vastly improved by the introduction of 66 feet of the hull amidships, and modernized by the substitution of twin screws for the old single screw, and by a thorough overhauling of the interior fittings and furnishings. With her great length, her powerful engines and thoroughly up-to-date appointments the "Kaiserin Maria Theresia" is to all intents and purposes a new ship.

The alterations were effected at Stettin, Germany, where the "Spree" was docked in the large floating dry-dock, cut cleanly in two amidships, the two halves of the hull pulled apart for a distance of 66 feet, and an entirely new section of hull built into the gap. The after part of the hull below the water line had to be taken apart, and the framing and plating entirely remodeled to accommodate the twin propellers which took the place of the old single propeller. New twin-screw four-cylinder engines were installed, the boiler plant was entirely renewed and, indeed, the whole engine and fireroom was brought up to modern practice, while entirely new upper and promenade decks were added. The vessel now has a length over all of 540 feet, with a beam of 52 feet, and a depth of 37 feet. She has a gross registered tonnage of 7,800 tons and a displacement of 13,600 tons. It will be noticed that she is a remarkably long vessel for her beam, the ratio of her length to breadth being 1 to 10·5. In this respect she is not unlike the steamers of the White Star Company which is the only company that has steadily adhered to the plan of building those big ocean steamers with an extremely long and narrow hull, the "Oceanic," the latest of these ships, having a ratio of beam to length of 1 to 10·4.

In the accommodation for passengers the "Kaiserin Maria Theresia" follows the general system of location, furnishing and decoration which characterizes the boats of the North German Lloyd Company. She has accommodation for 330 passengers in the first cabin, 140 in the second cabin and 400 in the steerage, while the crew numbers 200. The first cabin passengers are carried amidships, the second cabin aft, and the steerage forward. The dining room is situated amidships on the main deck, and is supplemented by two small dining rooms adjoining it. The main dining room is decorated on its walls and ceiling with paintings of Empress Maria Theresa, her husband, the Emperor Franz I., and Emperor Joseph II., and also of the members of the Imperial family. There are also several views of old Vienna at the time of the Empress. The paintings of the smaller dining rooms represent historical subjects from old Vienna and the lands of the Austrian crown belonging to the Empress. There is a promenade deck for the use of the first cabin passengers which offers an unobstructed walk of 310 feet, and is protected throughout its whole length by an awning deck

The hull of the steamer is divided into eleven watertight compartments which extend to the upper deck; and a commendable feature is the ample provision of boats of the largest size. The ship is driven by two triple-expansion engines of 17,000 indicated horse power, which will give the vessel a sea speed of about 19½ knots an hour. This, although considerably less than the speed of the "Kaiser Wilhelm," is well up to the average speed of modern passenger ships of this class, and is about the rate of speed aimed at and secured in the "Oceanic" of the White Star line. Each of the engines has four steam cylinders working on four cranks, which are arranged according to the principles of the Schlick-Yarrow-Tweedy system, which is designed to avoid vibration and is working with admirable results in several of the latest trans-Atlantic ships. The diameter of the cylinders is 43½ inches, 67 inches, 77 inches and 77 inches, the common stroke being 63 inches. The propellers, which are three-bladed, are of bronze, with a diameter of 18 feet 4½ inches; the whole of the shafting is hollow and is built of nickel steel. In addition to the main engines there are thirty-eight auxiliary engines which number among them 66 steam cylinders to be supplied with steam. The boiler plant consists of nine double boilers, 18 feet 7 inches in length by 15 feet 4 inches in diameter, and four single boilers 10 feet 3 inches in length, and 15 feet 4 inches in diameter. There are sixty-six furnaces in all with a combined total heating surface of 50,700 square feet, and a total grate surface of 1,531 square feet. The steam pressure is 156 pounds to the square inch. The boilers are collected in three separate groups each of which is provided with a smokestack 11 feet 7 inches in diameter, and reaching to a height of 92 feet above the grate bars.

The broadside view of the "Kaiserin Maria Theresia," which is herewith presented, shows her to have just about the right amount of sheer, striking in this respect a happy mean between the two straight lines of the "Teutonic" and the excessive sheer of the "Kaiser Wilhelm." The appearance of the ship is also aided by the judicious placing of the masts and funnels. In many respects she is not unlike the unfortunate "Kaiser Frederich," built by Schichau, of Elbing, which, it will be remembered, was returned to the builders on account of failure to make the contract speed.



NORTH GERMAN LLOYD LINER "KAISERIN MARIA THERESIA."

Length, 540 feet. **Beam,** 52 feet. **Depth,** 37 feet. **Displacement,** 13,600 tons. **Speed,** 19½ knots.

The New Element, Victorium.

Sir William Crookes has recently given an account to the Royal Society of his discovery of the new element which he calls victorium. It has a pale brown color and dissolves easily in acids. Its oxide is less basic than that of yttrium but more so than the greater part of the earths of the terbium group. The chemical properties of victorium differ in many respects from those of yttrium, but generally speaking it may be said to occupy an intermediate position between this element and terbium. It is admitted that the oxide of victorium has the formula $Ve^2 O^3$, its atomic weight is not far from 117. The photograph of the spectrum given by the oxide shows certain definite lines which have not been observed with any other body. The spectrum is obtained by the incandescence of the body is a vacuum tube; the light given off has been analyzed by a spectroscope of great precision and the exposure upon a photographic plate shows a series of interesting rays in the ultra-violet region. In order to examine the negative an apparatus has been constructed which will measure to the 1-100,000 inch.

Science Notes.

According to M. Casimir de Candolle (Arch. Sci. Phys. et. Nat.), grains of wheat which have been immersed in mercury for four years are still capable of germination, and have been found to produce normal plants.

The ideal specific gravity of petroleum spirit for motor carriage purposes is 0·680 at a temperature of 60° F. A depression of 30° F. causes an additional 15° to the specific gravity, and a corresponding rise necessitates a similar reduction from 0·680.

Six thousand barrels of whiskey are to be shipped from a bonded warehouse at Baltimore, they having reached the limit of their free storage without duty, having been in bond within a few months of eight years, for which time, by provision of the law, this commodity may be stored without being subjected to the internal revenue tax of $1.10 per gallon. It will be shipped across the ocean and stored in warehouses in England and Germany, and will be nearly all shipped back if the demand arises. The ocean voyage increases its excellence, and its market value, and it may return within a year to supply the heavy demand and give a return that pays, over the cost that it represents to produce the article.

The observatory on Ben Nevis, being the highest peak of the British Isles, 4,407 feet above the sea level, presents, as regards its observations, some peculiarities not found in those taken at ordinary altitudes. Observations have been made during clear weather on the one hand, and during foggy weather on the other hand. This has been done for thirteen years. The results are briefly as follows: In continuous clear weather it practically never rains on the mountain at all. In continuous foggy weather on the other hand, the average daily rainfall is almost exactly one inch. There is a large and continuous excess of barometric pressure in clear weather over that in foggy weather. The observatory at Ben Nevis, furnishes a record of the meteorology of the clouds. The fog which characterizes the climate of the mountain is nothing but cloud under another name, and in this respect the observatory is unique.

The effects of the great dynamite explosions at Avigliana (near Turin), on January 16, are described by Dr. M. Baratta in a privately printed pamphlet, says Nature. About 400 kilogrammes of nitro-glycerine and 12,000 kilogrammes of dynamite and gun-cotton were blown up. The first and stronger explosion, though it lasted little more than a second, presented three maxima of intensity, due probably to the successive explosions of magazines a hundred meters from that in which the nitro-glycerine was stored. Owing to the situation of the manufactory, the zone of greatest damage was very small; that in which windows were almost totally destroyed extended to a distance of 5½ kilometers; doors and windows were made to rattle as far as Crescentino (60 kilometers distant); and the sound of the explosion was heard at Pavia (140 kilometers), Varzi (145 kilometers) and Lugano (160 kilometers).

B. Lidforss has made some interesting observations on the attractive force exercised by the secretion of the stigma on the pollen-tube, chiefly on Narcissus tazetta. No distinct influence on the growth of the pollen-tubes was exhibited by artificially prepared organic acids—formic, acetic, lactic, succinic, tartaric, malic, or citric—nor by amides, glucosides, or tannins; but the almost immediate effect of introducing into the medium a few grains of diastase was to cause a deflection of all the pollen-tubes toward the grains. The constituent of the diastase which produced this effect appeared to be the proteid. The classes of substances which attract pollen-tubes are chiefly two, carbo-hydrates and proteids, the most important food-materials of plants. This indicates that the movements of the apex of the pollen-tube are simply a search for food-material. Similar results were obtained with other plants.—Ber. Deutsch. Bot. Gesell.

The recent excavations at the Argive Heræum in Greece have been most important. The sanctuary lies on the northeastern site of the Argive plain, between the ancient cities of Mycenæ and Tiryns and opposite the city of Argos. It was discovered in 1831, and some tentative excavations were made in 1836 and continued in 1854, but the whole was finally excavated in 1892-1895 by the American Archæological Institute, and the school of Athens under the direction of Dr. Chas. Waldstein, now Slade Prof. of Fine Art at Cambridge. The whole of the great temple was laid bare and the excavations also revealed traces on the upper slope of an earlier temple built before the Homeric age and burnt in 423 B. C., the whole pavement having been found together with traces of civilization leading back to a period of 2,000 years or more B. C. Of the second temple there was found only the base, but also sufficient remains of columns to enable a complete architectural restoration to be made; while higher up, says The British Architect, the polygonal pavement of the upper temple was discovered together with portions of the wall, so that the outline of its plan may be determined and even a fair restoration of the structure carried out.

The Typewriter and the Eye.

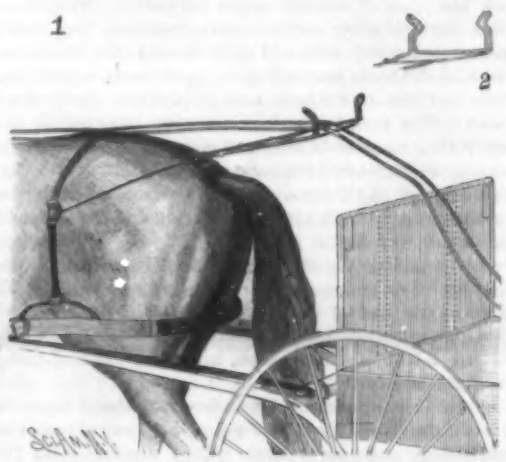
There is the general opinion among oculists that the eye is much relieved by the general introduction of typewritten matter. A recent medical work upon diseases of the eye gives a great many proofs in substantiation of this opinion. The characters are so large on the keys that there is no appreciable strain upon the vision, and when dexterity is attained the eyes can scarcely be said to be used at all. A vast strain is taken off the eye by writing with the typewriter instead of the pen, but the advantages of reading the type writing matter are even more important from a medical point of view, and the strain upon the hands is also slight. It is said that a person can work for eight consecutive hours, with slight interruptions, without the hands being conscious of fatigue. In using the typewriter the additional labor of focusing the eyes calls the muscles into undue use and the result is that many defects of vision which would not probably be discovered under normal conditions are brought to the front.

A REIN SUPPORT AND GUARD FOR HORSE HARNESS.

The accompanying engraving represents a simple device, patented by John T. West, of Bowling Green, Ky., for supporting the reins of a horse at such a height from the crupper that they cannot become entangled with the harness, or with the tail of the horse.

The device comprises essentially a spring-wire frame provided with guide-fingers at its rear end for the reins, and with divergent arms at its forward end for attachment to the crupper and hip-straps. Fastening pins, carried by the frame at each side, are designed to engage sockets in the back-strap or crupper.

The rein-guard, the inventor assures us, can be removed and replaced in a few seconds. The rear end



A REIN SUPPORT AND GUARD FOR HORSE HARNESS.

of the wire-frame projects just over the tail of the horse and supports the reins in such a position that they cannot sink. Carelessly as the driver may hold the reins, they will always be supported in proper position by the guard, without any possibility of their becoming ing entangled with the tail of the horse. The guard weighs but eight ounces.

Japanese Swords.

Mr. Gilbertson gives some interesting details as to the process of manufacture of the celebrated Japanese sabers. The blades of these sabers are formed of a metal prepared from magnetic iron ores and ferruginous sand. The steel is produced in the form of thin laminæ, and the workman commences by fixing one of these to the end of an iron rod which serves as a handle. To this are soldered other sheets until the mass has a length of 6 to 8 inches, a width of 2 inches and a thickness of ½ to ⅔ inch. This bar, brought to a white heat, is doubled upon itself and hammered until it has taken its original dimensions. This process is repeated fifteen times. Four similar bars are then soldered together, doubled upon themselves, resoldered and heated, this operation being repeated five times. By this process the superposed layers of metal becomes so thin that a saber is estimated to contain at least one million sheets of metal. Sometimes alternate layers of iron and steel are soldered together, and thus the blade presents a veined appearance. When the blade is finished the surface is scraped and the end formed to receive the handle; it is then ground to shape. To finish the blade, it is covered with a mixture of clay, fine sand and powdered charcoal. Formerly the clay was taken from Mount Inari, and the workmen first went through a form of invocation to the tutelary divinity, to ask permission to take the necessary material. When the layer is nearly dry, an ornamental design is traced by short strokes which penetrates to the surface of the metal. It is then heated over a fire arranged for the purpose, and when the proper temperature is reached, which can only be determined by long experience, the blade is plunged into a bath of water or oil. The saber is then sharpened, and for those of the best quality this operation is said to require fifty days' work.

Engineering Notes.

The British War Office has purchased some small steel shields to cover the vital parts about the heart. It is said they weigh about 7 pounds and turn bullets at 700 yards. It seems curious that on the very threshold of the twentieth century that we again resort to armor. The principle, however, is an excellent one, and a helmet with a vizor and a heart guard would be a great protection in the present conditions of war fare.

The colored people of Omaha have petitioned the City Council to get possession of the armorclad car used by President Lincoln during the war time, and to restore it to such a condition as to prevent further deterioration and make it available as a relic. The car is owned by the Union Pacific Railroad and is kept in the yards at Omaha. It was built at Alexandria, Va., in 1864, says The Railroad Review, and was made bullet-proof by means of boiler plates placed on the sides of the car.

A railroad school for candidates for men in training for appointments in the regular permanent railroad service in the operating department of the Prussian State railroads has recently been opened at Berlin, and six hours of instruction is given each week for a regular course. Twenty-seven different subjects are embraced, and much attention is given to railway accounts as a larger part of the students are candidates for the grade of railway clerks. All of the students must have had a certain prescribed education, and many of them are graduates of technical schools.

An inclined railway plane has been built up the face of the Palisades at Weehawken, N. J., for the transportation of trucks. The distance is only 290 feet and the incline is a very steep one. The road will be operated by three 2-inch steel cables, one acting as a safety rope in case of accident. There are also safety tracks attached to the machinery in the power house by which the cars will be attached to the cables; as one ascends, the other descends. Each car will carry four trucks and horses, and is capable of lifting 20 tons. It is somewhat similar to the incline in Hoboken, but is much steeper.

The Association of Engineering Societies consists of eleven societies including the San Francisco, Montana, Minneapolis, St. Paul, Detroit, St. Louis, Louisiana, Cincinnati, Cleveland, Buffalo and Boston. The engineering societies are bonded into an association for their mutual good and for the publication of The Journal of the Association of Engineering Societies. The aggregate membership of the societies composing the association is now very large and has virtually made good the loss caused by the withdrawal of the Western Society of Engineers. The assessment per member has steadily declined from $4.92 in 1894, to $1 in 1899.

In 1870, from July 24 to August 4, a period of eleven days, Germany was able to convey in 1,520 railroad trains 19,299 officers, 556,000 soldiers, 161,881 horses and 16,883 cannon and baggage wagons to the seat of war. So great has been the progress made by Germany during the intervening thirty years, that she could at the present time transport the same number of men and the same quantity of war material to the scene of action from two to four days, which shows the enormous strategetical importance of the railway. A great French military authority considers that by means of seven double-track railway lines, 1,440,000 men could be transported to the frontiers of Germany in twenty-four hours, and in 207 trains on each of the seven lines. This would be a total of 1,449 trains. Germany is not far behind France in this ability to mobilize troops, and 1,440 trains bearing 1,440,000 men can be dispatched from Berlin within twenty-four hours to any district of the empire, so that the two great neighboring powers could mobilize great armies and begin war simultaneously with its declaration.

Some interesting railway statistics for last year, published a Japanese vernacular contemporary, show that the number of special trains run numbered 18,089, representing a decrease of 9,288 as compared with the preceding year. Most of these special trains were for the transportation of material used in the construction of new lines, and 205 special military trains were run in connection with the grand military maneuvers held in the provinces of Settau, Kawachi, and Izumi. The number of trains derailed during the year amounted to 122, and the number of the carriages derailed 250. Collisions numbered, 39; interruptions of traffic, 1,331; obstacles laid on the lines, 45; mistakes of pointsmen, 87; and irregular use of the staff, 65. The people killed by trains numbered 261, and those injured 180, showing an increase of 12 in the killed and of 58 in the injured. Most of the people killed, however, committed suicide; the passengers affected by railway accidents being 18 injured and 13 killed. Twenty-four passengers were injured through their own carelessness. Nine railway employés were injured in accidents, and 22 were killed and 56 injured by self-negligence. The number of passengers carried reached 32,000,000 and the goods carried 8,800,000 tons. The traffic receipts amounted to 10,189,788 yen.

Correspondence.

Liquid Air Promotion.

To the Editor of the SCIENTIFIC AMERICAN:

I want to thank you for your timely and effective exposure of the liquid air "grab." It is worth something to the American people to have one fearless paper that is able and willing to throw the search-light of scientific truth upon subjects like this, and save innocent people from deception and loss. It is well that there is one incorruptible and unpurchaseable medium that stands between the public and the pseudo-scientific "promotion" sharks, to counteract, in some degree, the conscienceless exaggerations of those who have stock to sell, and who seem to have no difficulty in loading respectable newspapers with their alluring advertisements. Your issue, containing Mr. Maxim's article, with your editorial comments thereon, was eagerly perused by hundreds of clerks in the departments here, who had been abundantly supplied with liquid air "literature," that had almost created another Klondike fever among them, and it sobered many of them so that many thousands of dollars in the aggregate were saved to them thereby.

All honor to the SCIENTIFIC AMERICAN and to Mr. Maxim for puncturing this colossal bag of (liquid) wind!

L. S. PERKINS.

Department of the Interior, Washington D. C. March 19, 1900.

The Dams of the Nicaragua Canal.

To the Editor of the SCIENTIFIC AMERICAN:

In connection with the Nicaragua Canal question, it seems to me that one very important point has been touched upon very lightly,—too lightly, in view of its importance. I refer to the question of earthquakes.

I take it that we may consider the following statements as beyond controversy.

1. That there will be violent and severe earthquakes in the future, as there have been in the past, in the district through which the Nicaragua Canal passes.

2. That no large stone or concrete dam can withstand such shocks.

3. That the immense dams required in the canal, if built of stone or concrete, in the usual fashion, cannot reasonably be expected to last for as long as ten years, and that in bursting, through earthquake shocks, they may be expected to destroy large sections of the canal.

Since however, the canal is to be built, the only thing to do is to build a dam that cannot be destroyed by earthquake. To accomplish this result, I would suggest that the contracts require a dam constructed as follows:

Specification—All dams to consist of steel framework and a concrete filling. The framework to be of ample strength to support the full pressure of water and of the concrete filling, with the usual factor of safety. The steel framework to have all supports carried down to solid rock. The steel in no case to be in direct contact with the rock, but a casing or grouting of cement of at least 6 inches thickness to be between the steel columns and the drilled rock, i. e., the holes in the rock to be drilled 12 inches in excess diameter and the cement filled in between the steel column and the sides of the hole. The section of the dam to be of approximately inverted capital V shape, the only solid portion being the legs of the V, the space between the legs of the V being unoccupied except by tie bars and bracing, cemented to prevent corrosion.

The steel framework to be divided up into panels, so that there shall not be in any portion of the front or rear wall a space of an area of more than one square yard which is not crossed by beams or bracing. These spaces to be filled up with some such material as expanded metal, held in place by rivets. Where the pressure is greatest, several layers of this expanded metal to be used, back of each other, sufficient in number, when properly filled with cement, to give the requisite factor of safety.

The advantages of this form of dam are:

1. It gives really two dams, so that if one be seriously injured as a dam, it will still form part of a supporting structure for the other part.

2. No matter how severe the earthquake, it is not conceivable that the dam should receive such serious injuries as to permit any sudden discharge of water. The most that could happen would be that it would leak, and discharge the water slowly. With shutters or similar apparatus the leak could be checked and all serious damage avoided.

3. This composite structure would be so flexible that it is almost impossible for any earthquake to seriously affect its integrity.

In view of the fact that the wrecking of a masonry dam would cause damage to be estimated in millions, possibly tens of millions, of dollars and of the disorganization of commerce which would ensue, no precautions should be spared, and even if the above form were more expensive, it should be used. I believe, however, that when cost of erection is taken into account, this dam will be found to be the cheaper, on the whole. Incidentally, if this type of dam be adopted, most of the cost will be for material which will be bought and manufactured in the United States, and erected by skilled American workmen. It is always sound political economy to adopt, of two plans, that in which the cost is paid to the manufacturers of our nation and remains in the country, largely paid out in wages, in preference to paying the money out to cheap foreign labor. It is better to spend $80,000,000 on home-made steel and cement and $20,000,000 on foreign labor, than $20,000,000 on material and $80,000,000 on cheap foreign labor. The sides and bottom of the canal should, where there is danger, be constructed similarly, i.e., consist of steel framework and expanded metal with cement filling.

Allegheny, Pa. REGINALD A. FESSENDEN.

AMERICAN FREIGHT LOCOMOTIVES AND THE ENGINES OF THE "OCEANIC"—A COMPARISON OF HORSE-POWER.

We are told that "comparisons are odious," and the statement would seem to be based upon a fairly correct estimate of human nature; but as soon as we get outside of the range of human susceptibilities and apply our comparisons to insensate things, comparisons become not only extremely interesting, but at times a valuable means of increasing our general knowledge and our sense of the proper relative proportion of things.

The pictorial comparison to be found on our front page is based upon one of the mammoth freight locomotives which are being turned out in considerable numbers just now by the leading locomotive works of the country. In addition to the usual information as to dimensions and construction, Mr. R. Wells, the superintendent of the Rogers Locomotive Works, has favored us with particulars of some novel experiments which he carried out to determine the exact location of the center of gravity of this locomotive above the rails. He has also given us particulars of its horsepower and freight-hauling capacity on a level road, and it occurs to us that a comparison of the relative power of one of these engines when working up to its maximum indicated horse power with the maximum indicated horse power of the "Oceanic," the largest steamship in the world, will be attractive to that section of our readers that likes to have its facts enlivened occasionally with a touch of the fanciful and curious.

The locomotive shown is an extremely powerful Consolidation which was recently built by the Rogers Company for the Illinois Central Railroad for use on one of the divisions of their line where the grades are somewhat heavier than on the divisions connecting with it. It was designed to haul trains of a maximum weight of 2,000 tons over grades of 38 feet to the mile. The cylinders are 23 inches in diameter, by 30 inches stroke; the drivers are 57 inches in diameter and they carry 198,000 pounds weight of the locomotive out of a total weight of 218,000 pounds. The boiler, which is of the Belpaire type, is 80 inches in diameter at the smoke box; the fire box measures 42 inches by 132 inches, and there are 417 2-inch tubes which are 13 feet 8 inches in length. There are 252 square feet of heating surface in the fire box, and 2,951 square feet in the tubes, making a total heating surface of 3,203 square feet. The tender is exceptionally large, the capacity of the tank being 5,000 gallons, while the coal space has a capacity of 10 tons.

The increase in the diameter of locomotive boilers which has taken place of late years has necessitated their being carried above the tops of the wheels, with the result that the center of the boiler is in some recent locomotives as much as 9 feet above the rails. To the uninitiated these immense machines have an exceedingly top-heavy appearance, and it looks as though their stability would be endangered, especially when they are running at high speed around a curve. Before sending this engine out of the shops, the Rogers Locomotive Company made an experimental test to determine the exact location of its center of gravity. The result is certainly surprising, for although the top of the boiler is fully 9 feet above the rails, the center of gravity was found to be only 50½ inches above the top of the rails, that is to say, about 6½ inches below the top of the driving wheels. As a matter of fact, the great bulk of the boiler is very deceptive to the eye, and one is liable to forget that the greatest concentration of weight lies in the heavy frame, the wheels, the axles, cranks and running gear, and the heavy saddle and cylinder castings. The test was made by suspending the engine on the upper surface of two 3-inch steel pins or journals as pivots, the one at the front being located 6 inches in front of the cylinder saddle, and the one at the rear, 6 inches back of the boiler, both pivots being, of course, the same distance above the rails and on the vertical center line of the engine. After several trials, points of suspension were found which were in line with the center of gravity, which, as thus determined, was found to be 50½ inches above the top of the rail. As the bearing points of the drivers on the rails are about 56 inches apart, the base on which the engine runs must be 1·1 times as wide as the height of the center of gravity of the engine above the rails. It is evident from this test that the center of gravity of such a locomotive could be raised still higher without endangering the stability of the engine under the ordinary conditions of service.

A COMPARISON OF MARINE ENGINE AND LOCOMOTIVE HORSE POWER.

In order to secure a basis for comparison of the power of a modern freight locomotive with that of a modern steamship, we have chosen the greatest vessel of them all, the "Oceanic." This truly gigantic ship, which exceeds the "Great Eastern" in length and in displacement, is 704 feet in length, and on a draft of 32½ feet displaces 28,500 tons. As the depth of water in the entrance channels to New York harbor will not accommodate a vessel drawing that amount, for the purpose of this comparison we will suppose that the "Oceanic" is drawing 30 feet, at which draft she would displace about 26,000 tons. On this displacement her engines will indicate about 28,000 horse power when driving the vessel at a speed of 22 land miles an hour.

Now, it is estimated that the big Rogers Consolidation could haul about 3,250 tons weight of train at a speed of 22 miles an hour, on the level, and that while doing this work it would indicate about 1,760 horse power. Here then we have a basis of comparison, and we may apply it in two ways. Either we may ask how many of these locomotives would have to be crowded into the hold of the "Oceanic," and coupled to her main shafts, in order to drive her through the water at 22 miles an hour, or we may determine how many of these locomotives it would take to haul the "Oceanic" if she were placed upon a movable cradle of the kind designed by Capt. Eads for his Tehauntepec Ship Railway. In the first case, we know that when the main shafts of the "Oceanic" are making about 90 turns a minute, the engines are indicating about 28,000 horse power, which is their maximum capacity. On the other hand, we know that when the drivers of one of these locomotives are making about 150 turns a minute, and the maximum tractive effort is being exerted at the periphery of the wheels, it is indicating about 1,760 horse power, which represents its possible maximum indication at that speed. If now the sixteen necessary locomotives (the number being found by dividing the horse power of the ship by the horse power of the locomotive) were arranged in two lines, one above each main shaft, and the tractive effort of the drivers transmitted by means of friction wheels to the shafts, the speed of the rotation being reduced by intermediate gearing, in the ratio of 150 to 90, we should have the conditions shown in the upper engraving on our first page, where the locomotives, in double phalanx, are shown grinding merrily away at their unwonted task of driving a modern transatlantic liner.

To determine how many Rogers Consolidations it would take to haul the "Oceanic" over a ship railway whose grade is perfectly level, we will neglect the weight of the cradle and assume that its rolling friction is the same as that of a weight of loaded freight cars, equal to that of the ship. The displacement (that is, the weight of the water which the ship displaces at a given draft) on a draft of 30 feet would be about 26,000 tons, and dividing this amount by 3,250 tons, which is the maximum weight of train which one locomotive can haul at 22 miles an hour, we find that it would take just eight locomotives to haul the "Oceanic" by rail at a speed of 22 miles an hour. This result is particularly interesting as showing how quickly the resistance of the water to the motion of the ship increases with the speed. As a matter of fact it increases as the cube of the speed, with the result that, although the "Oceanic" could be moved at a canal boat speed of 2½ miles an hour by less locomotives than it would take to haul it at that speed on land, at a speed of 22 miles an hour it requires just twice the power on the water that it would on the land.

The "Oceanic," as she rests upon the ship railway cradle, represents both the dead and the live load; that is to say, the ship and the cargo. With a view to showing graphically what an enormous mass is represented by her 26,000 tons displacement, attention is drawn to the sketch showing an equivalent weight in loaded box cars of 40,000 pounds capacity, each of which with its load would weigh about thirty long tons. If this weight were made up into two separate trains each train would contain 433 cars and would be about three miles in length.

An Important Storage Battery Suit.

A decision has been handed down by the United States Circuit Court of Appeals for the First Circuit, at Boston, in the case of the Electric Storage Battery Company vs. the Hatch Storage Battery Company, which affirms the decision of the Circuit Court wherein the Hatch battery was held to be an infringement of the Brush patent owned by the Electric Storage Battery Company, and the latter court granted an injunction against the manufacture and sale of the Hatch battery. The Brush patent covers all batteries composed of "a plate or suitable support primarily coated or combined with mechanically applied oxide of lead or equivalent lead compound." The litigation has been pending for three years and the decision is a most important one.

THE MARINE DEPARTMENT OF THE TRANS-SIBERIAN RAILROAD.

BY WALDON FAWCETT.

Probably never in the history of transportation enterprises has there been constructed a railroad system which has been dependent to so great an extent upon auxiliary water communication as the Trans-Siberian Railway, which has, within the past few months, progressed to the point where uninterrupted communication across the continent is possible. Ultimately, when the whole great project has been carried out in its entirety, the proportion of the work of the system performed by water craft may be greatly lessened; but for years to come the shallow draught steamers are likely to constitute the connecting links between many sections of railroad. Nor indeed will the marine interests fostered by the new system be confined to this class of shipping. Many vessels of large size will be required to handle the commerce on the Pacific, the growth of which will be in a great measure resultant from the influence of the new railroad system; and it is significant that upward of a dozen vessels designed especially for such service are now building in the shipyards of the United States.

The final section of the road to be completed is in the neighborhood of 700 miles in length, and extends from the eastern shore of Lake Baikal to Stretensk. Communication between the last-named place and Vladivostock, the ultimate terminus of the line, is principally by boat. The Shilko River, on which Stretensk is situated, is a tributary of the Amur, and on these two rivers steamers are operated to the north end of another section of the railroad which follows the Ussuri River direct to Vladivostock.

Ultimately, of course, the main line of the railroad is to pass down the valley of the Amur to Vladivostock; but the consummation of this plan is certainly several years distant. The Manchurian Railroad, however, a short cut or branch road from Stretensk straight to Vladivostock, through Chinese territory, will it is expected, be completed within two years. While it may be taken for granted that upon the completion of this new Manchurian Railroad, much of the through business will take the all-rail route, there is no doubt that a constantly increasing volume of traffic will be developed in the territory drained by the Amur and its tributaries, and this will, of course, be handled almost exclusively by boat. Appreciating this, the Russian government has already taken steps to deepen the channels and otherwise improve the Shilko, Amur, and Ussuri Rivers. Not only have the rivers been buoyed so that the best navigable channel is clearly indicated, but upward of two dozen stations have been established at which daily records are kept of the depth of water. New charts of the rivers have been published and these will, ere long, be supplemented by others.

One of the avenues of usefulness in which the marine department of the railroad early figured was in the operation of huge barges on the Amur River. These vessels which conveyed all classes of constructive material to Stretensk, the head of navigation, were, together with the steamers which towed them, built at the Sentinel Works of Alley & Maclellan, at Glasgow, Scotland. The vessels were erected at the Scotch yard and then dismantled, shipped in sections to Siberia, and there re-erected by forces of workmen sent especially for the purpose.

The steamers or tugs were each 183 feet in length over all, 175 feet between perpendiculars, 36 feet molded beam, 8 feet depth and 2 feet 9 inches draught. Each is fitted with compound, surface-condensing engines of 600 indicated horse power, with cylinders 20 and 40 inches in diameter and 48 inches stroke. To these steam is supplied from two locomotive type of boilers, arranged for wood firing, and with a total heating surface of 2,200 square feet and a working pressure of 150 pounds. The barges designed to be towed by steamers of the class just described are each 210 feet in length, 35 feet beam, and 9 feet depth, and will carry a cargo of 400 tons on a draught of only 3 feet 6 inches.

Possibly the most striking transformation which has been effected in the entire system is found in the service on the Amur and Sungari Rivers, where the poorest type of Chinese junk has been supplanted by handsome new steamers which make regular runs of more than 2,000 miles per trip. The "Amgoon" may be taken as thoroughly typical of the vessels engaged in this service. She is a side-wheel steamer 160 feet in length over all, 24 feet molded beam, 8 feet depth, and 3 feet draught. Her engines also are of the compound, surface-condensing type, and the locomotive type boilers, like those in the vessels previously described, are arranged for burning wood fuel.

Another break in the rail line which requires boats to serve as a connecting link is found at the southern end of Lake Baikal, a point at which the mountains extend practically to the water's edge. An expenditure of many million dollars would have been necessitated to put the railroad through this section, and so it was decided to substitute instead a fleet of ferry-boats, which now transfer trains of cars back and forth just as is done at numerous ports in the United States. An ice-breaking steamer, somewhat similar in design to those in service on the Great Lakes of America, keeps the channel open in winter. The trip across the lake is about forty miles in length, and the vessels employed on the route are especially designed for the service.

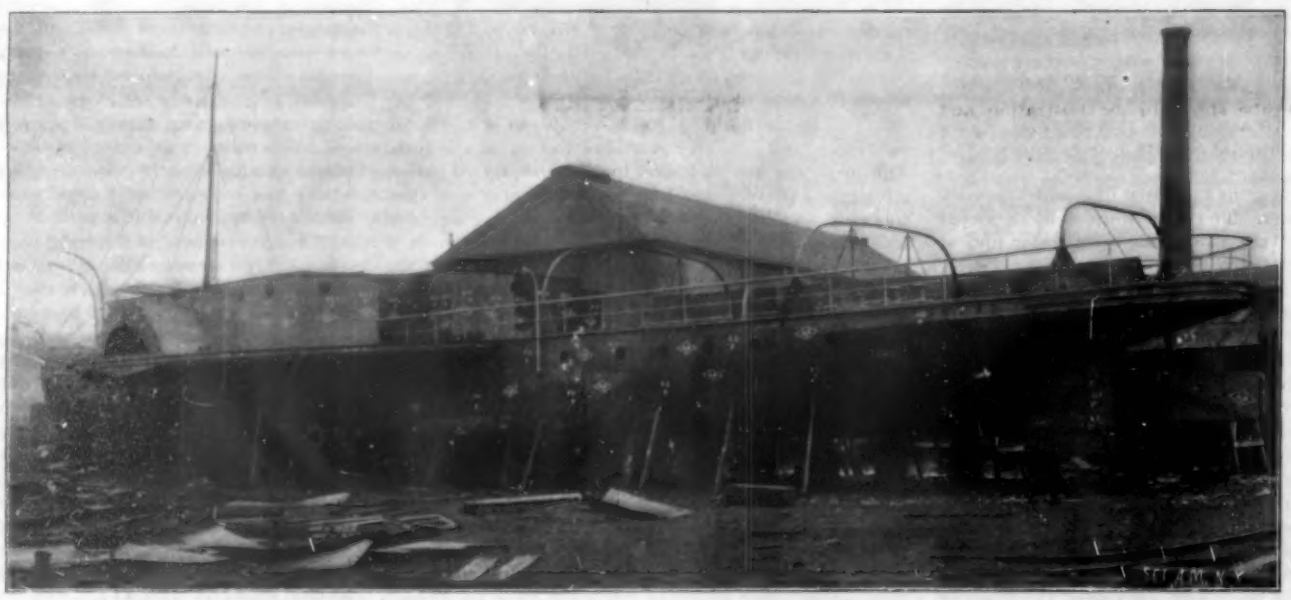
Another very interesting type of vessel shipped from British yards for service in Siberia is a class of stern-wheel steamers, each of which is 91 feet 6 inches in length over all, 80 feet between perpendiculars, 20 feet beam, 3 feet 6 inches depth, and 1¼ feet draught. These vessels have high-pressure engines and boilers of the locomotive type. The vessels were built in riveted sections weighing about 15 tons each, and shipment to Siberia was thus made possible. It will be noted in the accompanying illustrations what precautions the builders took to plainly mark every component part of the vessel in order that there might be no possibility of confusion during the process of re-erection.

The center of maritime activity in connection with the Siberian system is at Vladivostock, in the improvement of which port millions of dollars have been spent, and where there are magnificent piers and an excellent floating dry-dock. Ultimately Port Arthur may in some degree divide supremacy with her; but this is a long look ahead.

The development of the maritime phase of the project will henceforth be largely under the control of the Chinese Eastern Railway, which is the official name of the short-cut line through Chinese territory, previously mentioned. To all intents and purposes, this latter line is a Russian institution, being nothing more nor less than the final section of the Trans-Siberian Railway; but in the transaction of business the two corporations are kept rigidly distinct. That in reality, however, they are one is evidenced by the fact that the immense docks constructed at Vladivostock, when it was supposed that that city would be the main terminus of the Trans-Siberian line, have been transferred to the Chinese Eastern Company.

The Chinese Eastern Railway will operate a fleet of eighteen vessels, averaging 4,000 tons each, for the purpose of carrying freight from Shanghai to Port Arthur and Vladivostock. For the maintenance of this fleet, large repair shops are being constructed at Port Arthur. Much has been written regarding the triumphs of American tools and American locomotives in the construction of the rail line, and it would seem that the creditable record is to be maintained, for the Russian officials have stipulated that the entire equipment of these new repair shops, including engines, boilers, and machinery, shall be purchased in America. This, too, in the face of the fact that several European firms offered to supply the equipment at a lower figure. A representative of the Russian officials has been in this country for several weeks past filling out the equipment specifications of the new Port Arthur plant, and has placed contracts aggregating upward of $200,000 with American manufacturers.

STEEL BARGES FOR SERVICE ON THE AMUR RIVER—TRANS-SIBERIAN RAILROAD.
Length, 210 feet; beam, 35 feet; depth, 9 feet; Capacity, 400 tons on draught of 3 feet 6 inches.



PADDLE STEAMER "AMGOON," FOR THE AMUR RIVER PASSENGER SERVICE—TRANS-SIBERIAN RAILROAD.
Length, 160 feet; beam, 24 feet; depth, 8 feet; draught, 3 feet; Compound Surface-Condensing Engines supplied by two locomotive wood-burning boilers.

American Scientists Honored.

The bi-centenary of the Prussian Academy of Sciences was inaugurated on March 19 at the castle at Berlin in the presence of the emperor and prominent officials. The scene was of great splendor, as, with a fanfare of trumpets the procession entered, headed by the high state dignitaries and generals and ministers bearing the imperial insignia. There were representatives of various universities present and three Americans were elected: Prof. Josiah Willard Gibbs, of Yale University, Prof. H. A. Rowland, of Johns Hopkins University, and Prof. William James of Harvard.

PROF. PICTET'S EXPERIMENTS WITH LIQUID AIR.

With the establishment of the Tripler and the Ostergren-Berger plants, atmospheric air has been liquefied in quantities which have surpassed the expectations even of those scientists who for years have made the physics of low temperatures their special field of investigation. As a scientific feat, the liquefaction of air in large volumes is certainly startling, but the practical value of the achievement is still to be demonstrated.

A project for the industrial utilization of liquid air has been formulated by Prof. Raoul Pictet, of Geneva, Switzerland, a physicist who for nearly twenty-five years has been an authority on liquefaction of gases and the chemistry of low temperatures, and who, we are pleased to state, has expressed his intention of becoming an American citizen. His industrial application of liquid air consists in the dissociation of its nitrogen, oxygen, and carbon dioxide, gases which are obtained in such large quantities and at such low cost that they can be profitably used in the arts.

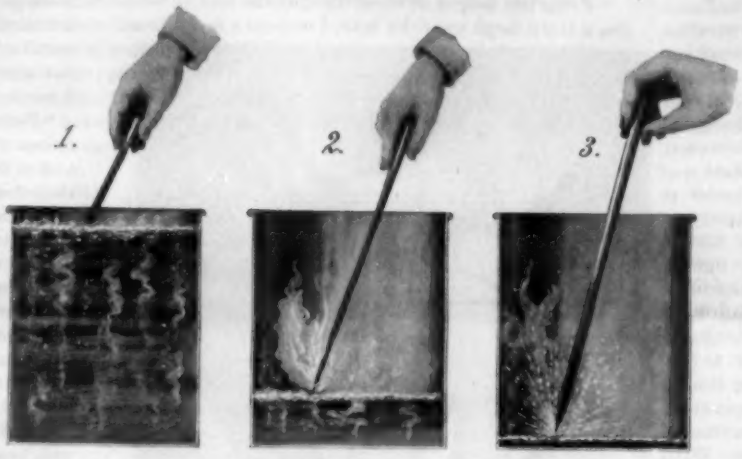
Up to the present time, liquid air has been produced at pressures which vary from 1,250 pounds to the square inch in the Ostergren-Berger system to 2,000 pounds and more in the Tripler and Linde processes. These enormous pressures require the expenditure of so much energy that the rectification of the liquid air is not commercially profitable. The germ of Prof. Pictet's project is found in his discovery that air can be liquefied at the astonishingly low pressure of 15 pounds to the square inch.

In the Pictet system, air is liquefied by means of liquid air. The principal of the Geneva physicist's discovery can be admirably illustrated by means of the experimental apparatus shown in Figs. 5 and 6. Within a bath of liquid air contained in a Dewar bulb, a coiled tube is plunged, one end of which is connected with a hand-pump and the other end of which is bent to discharge into a vessel. Gages can be provided to indicate the pressure. Atmospheric air pumped into the tube at a pressure of but 15 pounds to the square inch gives up its heat so suddenly that the liquid air in the bulb boils violently and the air within the tube liquefies and flows into the receptacle in an endless stream so long as the pump is in operation. At a lecture recently given by Prof. Pictet at the Engineers' Club in New York, a glass worm was substituted for the coiled metallic tube, shown in our illustration, and an enlarged image of the apparatus was projected by means of a lantern on a screen. The gases could be distinctly seen liquefying within the tube.

One of the most remarkable features of this method of condensing air at low pressures is the means of constantly maintaining the initial supply of liquid air. If the coiled tube is so bent that its mouth discharges into the bulb, the liquid air, it will be found, can be produced in volumes which not only compensate for the loss due to evaporation, to radiation, and to the solidification of carbon dioxide, but a remainder will be left which can be reserved for further use. With the variation of the pressure there will also be a variation in the quantity of liquid air obtained. This maintenance of a constant supply of liquid air within the Dewar bulb or other receptacle, constitutes an important element in the Pictet process of dissociating the constituents of liquid air.

Atmospheric air is composed essentially of nitrogen and oxygen in approximately the proportions of 4 to 1, with traces of carbon dioxide and watery vapor. The nitrogen and oxygen, owing to the exceedingly slight chemical affinity of the nitrogen, are merely diffused and not chemically combined. When air is liquefied the nitrogen and oxygen are condensed almost simultaneously, and the carbon dioxide solidifies. When a jet of liquid air is directed against the side of a vessel, the carbon dioxide solidifies in the form shown in Fig. 4.

Nitrogen boils at a temperature of —194·4° C. (—318° F.) and oxygen at —181·4° C. (—294·5° F.). In a vessel containing liquid air from which the carbon dioxide and moisture have been filtered off, the nitrogen will evaporate first, owing to its lower boiling point, leaving the oxygen behind. The process is akin to that of distilling water and alcohol in producing pure alcohol. Of a given quantity of liquid air approximately 50 per cent will be pure nitrogen, 30 per cent nitrous oxide, and 20 per cent oxygen, the carbon dioxide having been previously removed. The first nitrogen evaporated will not support combustion. The flame of a match will be immediately extinguished (Fig. 1); and not until the layer of nitrous oxide gas is reached is it possible for combustion to take place (Fig. 2). As the level of the rapidly boiling liquid falls, layers of gas richer in oxygen are reached, until finally, when four-fifths of the original quanty of liquid air have evaporated, oxygen alone remains. As this liquid oxygen boils away its purity increases, until at last a point is reached when its purity is such that steel can be burned, a sufficient proof of its high quality (Fig. 3).



Evaporation of Nitrogen. Evaporation of Nitrous Oxide. Evaporation of Pure Oxygen.

THE SEPARATION OF LIQUID AIR INTO ITS CONSTITUENTS.

With the possibility of liquefying air at low pressures

Fig. 4—SOLIDIFICATION OF CARBON DIOXIDE PRODUCED BY JET OF LIQUID AIR.

and its separation into its constituents, the collection of the oxygen after the evaporation of the more volatile nitrogen is a matter of no great difficulty. At the lecture before the Engineers' Club, already referred to, a small apparatus was set in operation which proved the feasibility of Prof. Pictet's scheme. The apparatus in question comprises primarily two parts,—a liquefier (Fig. 7), and a gasometer. The liquefier consists of a worm immersed in liquid air poured in through a funnel, the end of the worm being bent so that its mouth is located immediately above the funnel. The gasometer is merely an ordinary water-sealed gas-holder of 600 liters capacity. After the nitrogen had been drawn off, the liquefier and gasometer were connected, and sufficient pure oxygen was obtained to fill the gas-tank in less than one minute at 15 pounds pressure. The oxygen generated was used at the lecture in an oxy-hydrogen jet to produce a limelight.

In the industrial application of Prof. Pictet's system (Fig. 8) the atmospheric air at normal pressure enters a supply pipe and passes through a filter, which removes impurities and foreign matter. After having been purified, the air is compressed and forced into a cooler containing a cooling-coil, serving the purpose of reducing the temperature of the air after the compression. From the cooler the compressed air enters a chamber containing pipes through which liquid oxygen is flowing, whereby its temperature is further reduced. It then enters the pipe, *F*, leading to the separator, *G*. Within the separator are a number of superposed trays, containing liquid air, through which is conducted a coiled pipe connected at its upper end with the pipe, *F*, and at its lower end with the pipe, *H*, whereby the air is delivered into a filtering chamber, *I*, at the top of the separator. The cooled air passing through pipe, *F*, enters the coiled pipe lying in the liquid air on the trays, liquefies, as we have seen in the experimental apparatus previously described, and discharges into the filtering chamber, *I*, where the solid carbon dioxide is deposited. Then the liquid air flows into the trays below and compensates any loss in the liquid air on the trays due to evaporation. As the liquid air passes from tray to tray, the more volatile nitrogen separates from the oxygen and enters a pipe, *J*, connected with the top of the separator, and flows into the tubes of a nitrogen chamber, whence it may be led off into gasometers.

When the liquid air reaches the lowermost tray, if nitrogen will have completly evaporated, leaving only pure oxygen, which is collected in the pipes of the oxygen chamber and is then drawn off as desired. The intermediate space contains mixed oxygen and nitrogen, or nitrous oxide, which, like the other gases is drawn off by a pipe, *M*, leading to the collecting pipes of a mixed nitrogen and oxygen compartment. By an ingenious system of gate valves, located at the upper levels of the trays, the liquid air can be cut off at any point in its descent, so as to obtain oxygen of any desired degree of purity. If, for example, it be desired to collect a supply of oxygen containing 50 per cent nitrogen, the gate valve at the proper intermediate tray is closed, thus cutting off all the trays below and leaving only a sufficient number in action to produce the 50 per cent oxygen. If 30 per cent oxygen be desired, the gate at a somewhat higher tray will be closed. Several nitrous oxide compartments will be provided, each receiving liquid oxygen containing more or less nitrogen. For pure oxygen all the trays will be employed.

Before air can be liquefied by means of this apparatus it is evident that the evaporating trays of the separator must contain an initial supply of liquid air. In order to produce this initial supply, atmospheric air will be liquefied, as in the Ostergren and Berger* method, at a pressure of 1,250 pounds, maintained for a period of eight hours. After the necessary amount of liquid air is thus obtained, the compressors will operate at any desired pressure above 15 pounds, the losses in the original volume of liquid air, due to evaporation, solidification of carbon dioxide, and radiation, being compensated for in the manner previously mentioned.

The volumes of the gases separated by the Pictet process are enormous. Prof. Pictet states that a 500 horse power plant after its initial supply of air has been liquefied, will produce in twenty-four hours, 1,000,000 cubic feet of oxygen, 2,000,000 feet of nitrogen at atmospheric pressure, and, as a by-product, 1 short-ton of solid carbon dioxide.

The small cost at which these gases are separated is even more astonishing than the large quantities in which they are produced. The potassium chlorate process now in general use yields oxygen costing from $2 to $3 per cubic yard. By the fractional distillation of oxygen from air liquefied at low pressures, 20 cubic yards, it is said, can be produced for one cent.

Of what industrial value is this solid carbon dioxide,

Fig. 5.—PICTET'S EXPERIMENTAL APPARATUS FOR THE LIQUEFACTION OF AIR AT LOW PRESSURES.

Fig. 6.—METHOD OF PRODUCING LIQUID AIR.

*See SCIENTIFIC AMERICAN for July 15, 1899.

this liquid oxygen and nitrogen? The carbon dioxide filtered from the liquid air can be sold to brewers and makers of carbonated waters and beverages. It is claimed that the profits of the selling of the carbon dioxide will pay for the cost of operating the plant.

Oxygen, as Prof. Pictet has aptly termed it, is the very bread of industry. It burns the coal beneath the boilers of our locomotives and steamboats. It supports the flame of light and heat giving substances. It is the life-sustaining element in the air we breathe. Oxygen produced in large quantities at a low cost can be employed in well-nigh every art. Every industry is dependent on the calorific force of coal. Supplemented by oxygen not only can the calorific energy be increased, but the amount of fuel used can be reduced. In firing a steam-boiler, by assisting the combustion of the coal with 50 per cent oxygen (oxygen purer in quality would burn out the fire box), a quantity of fuel can be saved equivalent to that usually lost in heating the nitrogen of the air. Moreover, lignite, bituminous coal, and fuels of low calorific value can be employed. With a draft of oxygen of constantly increasing purity Prof. Pictet claims that the temperature of a reducing furnace can be raised 600° to 800° C., with the result that a piece of steel can be heated in half the time usually required, to a temperature even higher than may be necessary, with a saving of 40 per cent of the fuel ordinarily employed. With oxygen produced at low cost, iron, steel, and bronze can be easily welded and soldered. He suggests that framed iron structures and the pieces of metallic vessels can be fused together with the oxygen blow-pipe, thus dispensing with the use of rivets and gaining in strength and rigidity. With the supply of cheap oxygen it would be possible to obtain a more efficient system of street lighting than is at present possible. The cost of manufacturing such chemical products as nitric acid, sulphurous and sulphuric acid, and ozone, in all of which oxygen is an important element, can be very considerably reduced. In hospitals, schools, factories, offices, and theaters, the air could be replenished with oxygen as it became vitiated.

Pure nitrogen is obtained by the Pictet process only in the gaseous state; it is collected in various degrees of purity, and like oxygen, is industrially useful. By chemical synthesis ammonia and its various modifications can be made, as well as nitric acid and its derivatives, and the potassium cyanide so essential in gold mining.

If Prof. Pictet carry out his far-reaching project for the separation of the constituents of liquefied atmospheric air—and, indeed, he has already begun the erection of a plant for this purpose—he will change the methods of industrial processes more extensively than falls to the lot of most physicists. His process, if it prove successful, will affect the metallurgical industries, vastly influence steam and civil engineering, and introduce new methods for the commercial production of the most important chemicals used in the arts.

Petroleum Deposits on Saghalin Island near Eastern Siberia.

An Austrian mining engineer, Mr. F. F. Kleye, who for many years was engaged in the oil industry of Galicia, and, later on, in the same industry in Java and Sumatra, made, in 1898 and 1899, extensive investigations on the occurrence of naphtha on the island of Sagdalin, in Eastern Siberia. On his return Mr. Kleye rendered a detailed report of his observations to the Society of Austrian Mining Engineers, from which the following remarks are an abstract:

"In my search for the naphtha deposits on the island of Saghalin, I went from Alexandrowsk, on the west coast of the island, into the interior as far as Derbinsk, on the River Tym, whence I followed the river down to the eastern coast. After much trouble I succeeded in securing the services of some Russian-speaking Orotchons, who make their living in raising reindeer, and are well acquainted with the country. From these people I learned that far up in the north naphtha, called, 'Nephtogen' by the natives, occurred in many districts.

"After a voyage of about a week we arrived at Wal, where the Starost (mayor) informed me that he knew of two large naphtha deposits, of which one, he said, was situated near the River Nutowo and the other at the source of the Boatassin River. The next day we reached a hill called 'Nephtogengora' (naphtha mountain). While advancing over the last few miles, along the river, I noticed that the water of the stream was entirely covered with a coating of oil, and a heavy smell of naphtha announced that we were approaching a great deposit. We then came to the first naphtha sea, situated between two hills, and after having crossed the hills, we reached the second oil lake, which was far larger than the first. What I here saw really surpassed all expectations. I had never in my life seen or heard of, such immense lakes of naphtha.

"The next morning I began my investigations. This liquid naphtha I found to possess a specific weight of 0·925 at 14½° Celsius, and was of a reddish-brown color. Oil taken from another deposit had a greenish red-brown color, and a specific weight of 0·9055 at 14½° Celsius. Later on when I arrived at Alexandrowsk I distilled the oil and found that a quantity of 2½ quarts, heated to 150° C., contained only a few cubic centimeters of benzine, and at a heat of 300° Celsius 27 per cent kerosene. The heat was then developed to 500° when a first-class lubricating oil was obtained.

"From the height of these hills, at the foot of which lies a third large naphtha lake, I noticed a large broad, gleaming surface, and on nearing it, discovered another large lake, 1,435 feet long and 280 feet wide. At the edge of these four lake-like deposits there were numerous smaller oil wells, from which the oil continually

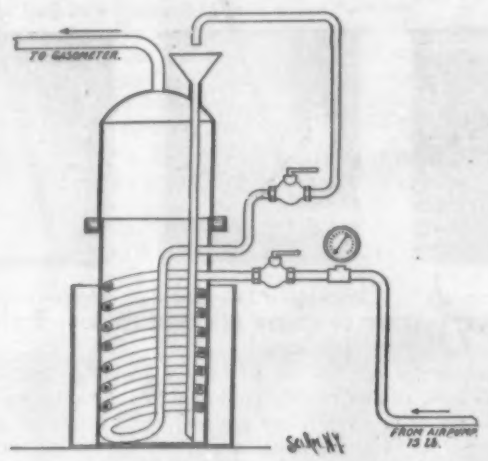


Fig. 7.—PICTET EXPERIMENTAL LIQUEFIER.

exuded under strong pressure. Further up the Nutowo River I also found considerable deposits of naphtha.

"The various hills stretch in the direction of the meridian, which is also the direction taken by the oil streams; voluntary courses I could nowhere find; furthermore, in numerous diggings I could find no beds. At one digging I penetrated first a 10-foot deposit of asphalt, then 10 feet of sand, before reaching the more solid foundation of clay. In spite of all safety measures it was not possible to control, without pumps, the underground water from pressing upward, and the digging had therefore to be abandoned; in spite

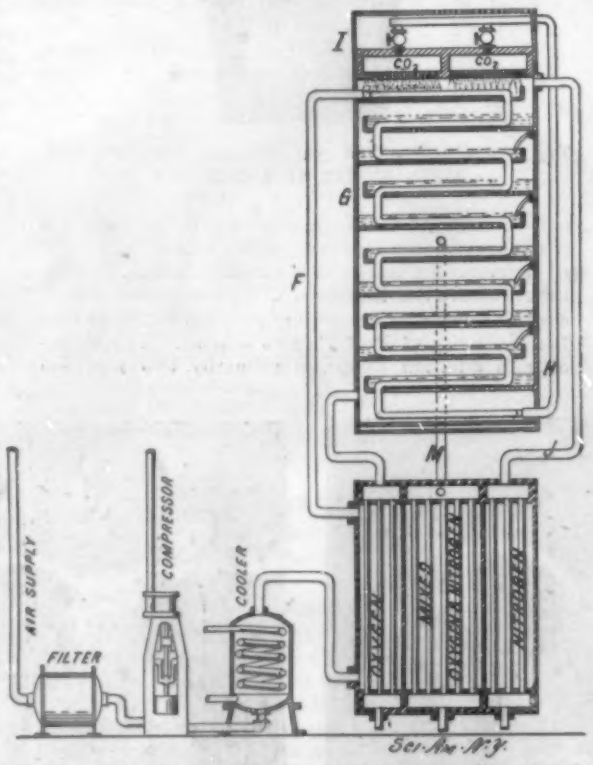


Fig. 8.—PICTET'S INDUSTRIAL LIQUEFIER AND SEPARATOR.

of all these obstacles, however, the exodus of oil was so great that a considerable supply underneath can assuredly be counted upon.

"After four days' work, and after I had minutely taken the location of the most important deposits, we began the return journey, during which I marked the entire way with the compass. On the first morning we reached by boat the mouth of the Hagdusa River. We landed here and continued on land across an almost level plateau. After walking about four versts we came in sight of the outlying hills, and another verst brought us to the naphtha deposits at the source of the Boatassin River.

"The entire outcrop line, forming more or less naphtha deposits, runs along the river to a long line of hills; the direction of these hills was also parallel with the meridian. Although these naphtha deposits were not so immense as those on the Nutowo by far, they are of great importance in view of the fact that they are scarcely twelve versts distant from a good sea-port, possessing accommodation for the largest ships, and also since the country offers practically no obstacles in the way of transporting materials, laying conduits, etc.

"The entire east coast of Saghalin, as far as examined, belongs to the 'tertiary formation.' All naphtha outcrops that I saw extend in the direction of the meridian. The naphtha deposits are embedded, without exception, parallel in the axis of the anticlinal flexure of the strata, and are very rich.

"Furthermore, when the important difference between the specific weight of naphtha of 20 feet depth and of that lying open is considered, it may be accepted that the deposits will supply raw oil sufficiently rich in kerosene. It is certain, however, they will supply a far richer raw oil than the wells of Baku, to which the raw oil of the eastern coast of Saghalin is very similar. It is, therefore, to be expected that not only a second Baku will rise, but that Saghalin 'Baku' will far surpass the present 'Baku.'

"It must be remembered, in prophesying the development of Saghalin, that it is only possible to reckon on a shipping season of from 7 to 8 months; the short stoppage during winter should, however, be outweighed by the extremely favorable shipping facilities, which are not surpassed anywhere in the world. With regard to the working of the naphtha deposits, it would be comparatively easy to transport the oil in tank steamers to a point near Vladivostok, where extensive refineries could be erected."

Since the foregoing was written, an English syndicate with a capital of $500,000 has been formed for the purpose of taking over the three naphtha deposits described above. The syndicate which is composed of three large London firms is called "The Saghalin and Amour Petroleum and Mining Syndicate, Limited," head with offices in London.

Since the English have taken the lead, the attention of the mining world will no doubt speedily be turned to Eastern Siberia with the result that foreign capital will find a way to the development of the rich mineral deposits of that country.

A Generous Inventor.

Inventors as a general rule are more or less so carried away with the development of their ideas that they give little thought to the business management necessary to make the invention financially lucrative.

But we have an exception to this statement in Mr. George Eastman, of Rochester, New York, the inventor and promotor of the Kodak camera, now so familiar in all parts of the world, who, trained to business methods in a banking establishment, retired and began the manufacture of the gelatine dry plates some twenty years ago mainly for the use of amateur photographers.

In the development of this new industry his attention was drawn to the need of some substitute for glass, and it was not long after before the roll holder attached to the back of the camera for holding in place a roll of sensitized paper was introduced, by which a large number of negatives could be taken in sequence, thereby dispensing with the heavy weight of glass. This led to the construction of a new special miniature camera, and its introduction, in 1888, by Mr. Eastman, when the phrase attributed to him, "you press the button, we do the rest," became so popular.

It may be considered as a certainty that this popularization of photography, while it seemed repulsive to the majority of amateurs, did more to interest the general public in photography and its kindred industries than any other event since the time of Daguerre. It was a good business stroke and prepared the public for further improvements which Mr. Eastman subsequently inaugurated by substituting for paper a rollable transparent celluloid film. Thus, by exercising excellent judgment in giving the newly created photographic public goods of superior and uniform quality at the same time satisfying the many varied conditions, Mr. Eastman succeeded in building up a business which has many times exceeded his original anticipations. His work resulted in the establishment of many new factories as well the changing of the character of the photographic trade, not only in the United States but abroad.

So it is with pleasure that we chronicle the gift by Mr. Eastman himself, a type of the energetic American, of $200,000 to the Rochester (N. Y.) Mechanics Institute without conditions.

The money is to be expended in enlarging the present building. A year ago he distributed several thousand dollars among employés, according to their terms of service.

Thus the people of his own city are benefited by his generosity, while the public at large derive benefit from the use of his inventions and appliances. He has been most successful as an organizer and leader of large corporations.

SOME AMERICAN MUMMIES.

BY PROF. C. F. HOLDER.

The history of embalming in Egypt is well known, and it is a more or less interesting study to attempt to compare the making of mummies in the East and in America with a view to throwing light on the singularities and religious observances which formed a part of the ceremony of mummification. From a translation of sepulchral texts in Egypt it has been learned that mummies were made there to keep the body inviolate and ready for the return of the soul at the time of resurrection. The Egyptians seemed to recognize four parts in man—the body, the soul, an intelligence, and an "appearance," "eidolon." At death these were separated, and then intervened a period of from three thousand to ten thousand years.

During this time the soul traveled the under world as a penance, while the intelligence wandered through space. As these parts were to return at the end of the time indicated, it was considered necessary to preserve the body from corruption, and in the attempts to accomplish this we find the reason for embalming among the ancient Egyptians, their pyramids, their secret burials, and the extraordinary methods of hiding the dead, customs which have been of the greatest value to archæologists and students of man and the human race. The embalming process was carried on with greater or less ceremony and expense in proportion to the wealth of the deceased; and, if the latter were a king or a member of the royal family, or a wealthy man, no expense was spared to embalm him in a lasting manner, and to place the remains in a well-built tomb.

The embalming was carried out on a regular system, there being four rituals to govern it. The first related to the incisions to be made in the body. The second was a manual treating of the gums, resins and spices to be used, the bandages and elaborate descriptions as to the method of binding the body and the prayers to be recited at each stage of the work. Third, the water ritual giving the litanies to be recited while the body was being taken by water to its last resting place; and fourth, a work containing the funeral ritual given when the body was placed in the tomb. These books were for the instruction of the priests and operators. The process of embalming was divided. First came the evisceration, taking about two weeks. This was followed by the salting or bituminizing, which took thirty days; then came the spicing and bandaging, occupying thirty-five days, or seventy-two days in all.

The great cemeteries of these days all had establishments for making mummies attached to them, as crematories are found to-day; and the professional embalmers constituted an army of people in themselves. According to Edwards, there were never less than eight hundred bodies in process of mummification in the workshops of the necropolis of Memphis. The method of treatment depended upon the rank and wealth of the dead. In the case of a poor man the bandages would be coarse; but if the deceased was wealthy they were of the finest linen. Each finger and limb were bound, twelve hundred and fifty yards having, in some cases, been unrolled by investigators—nearly two-thirds of a mile of bandages three or four inches in width.

There were many methods of making mummies, and time has shown that those of the Theban epoch were the best, the bodies after centuries being so flexible that they can be bent without breaking. This was, it is supposed, due to the expensive ingredients employed.

Mummies of some kind are found in many lands, and it is interesting to note that they occur in various parts of the United States, possibly the most interesting coming from the caves of Arizona. The two shown in the accompanying photographs, by Maude, of Los Angeles, were found in cliff dwellings in that territory. According to Lawson, the Santee Indians of South Carolina preserved their dead by embalming with certain roots, after which they dried the body and covered it with the bark of the pine or cypress. Finally, the skeleton was secured and wrapped in cloth made of opossum's hair, the remains then being placed in a box. Others were wrapped in deerskins and stored in the Quiogozon, which was the royal tomb. Perfect mummies have been found in the caves of Kentucky. One enveloped in rough clothes and wrapped in deerskins was found ten feet below the surface in a cave. It was the body of a woman, the hair shaven off according to the custom. Beneath the outer deerskin was another skin of the deer; then came a cloth formed of twine. Inside of this was a cloth resembling this, but covered and ornamented with brown feathers.

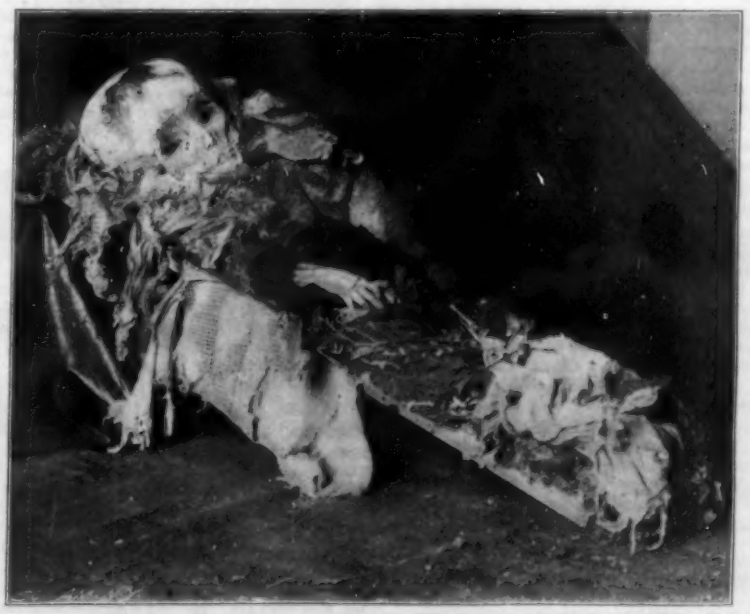
The natives of the Northwest embalmed their dead. The body was usually doubled up and placed in a case of fur or grass, made for the purpose. The Alaskan Commercial Company secured from the seal islands of the company a mummy supposed to be one hundred and fifty years old, which shows that this method of burial has been followed many years. It was discovered in a cave, on Kagamale Island, filled with sulphurous vapors which came from crevices in the rock. Eleven mummies were found. One, the chief, was held by a basket-like coffin, or structure, four feet in height, and evidently made with the greatest care. The material with which the remains were wrapped were matting, woven from seaweed in a very skillful manner, and skins, among which was a fine skin of the sea otter; over all was a net made of the sinews of the sea lion.

INDIAN MUMMY FROM CLIFF DWELLING, ARIZONA.

In many of the so-called mummies of this continent the body was placed in a sitting position. Several were found by the writer on San Clemente Island, California, doubled up, the head resting on the knees, while in front of the face and behind the head were placed flutes of bone inlaid with the pearly abalone.

The mummies shown in the illustrations have been carefully prepared. The one unopened with distorted face, being well preserved; wrapped in skins and firmly bound and finally incased in a covering of basketry. The so-called mummy caves of Arizona from which mummies have been taken, are very interesting and elaborate in their structure. One is known as Mummy Cave Ruin, and is in Del Muerto Cañon and known to the Navajos to-day as Tse-i-ya-kin. It stands about 80 feet above the bed of the cañon on the face of the cliff with a commanding view and is placed in a natural weathering. It is believed that originally there were twenty rooms in the western cave, and fourteen can be distinguished to-day. In the eastern cave about forty-four can be distinguished, and it is estimated that originally the ruin represented ninety rooms, affording a home for possibly sixty people. Many of the rooms are 20 feet wide and 15 feet across, and were two stories in height. What is called the eastern cave, or the mummy cave, is to-day a most picturesque ruin and steps have been taken by the government for its preservation. The houses of stone are packed in under the great cliff where the stone has weathered out and the falling ruin has aided materially in forming the talus that reaches down, covered with the stones used by the ancient builders, to the bottom of the cañon. Windows and doors remain intact in many rooms and the stories can readily be traced by standing walls. If these picturesque ruins were in some valley in Egypt they would attract the attention of thousands, but here they are visited by the student and the scientific man alone, and by but an occasional tourist who strays into the region.

In Egypt, mummies of crocodiles and cats are common, but the mummification of animals in America appears to have been rare. On the island of San Clemente mummified dogs have been found, and are to be seen in the museum of Throop University, Passadena. They were tanned in some way and then wrapped in basketry of seaweed.



INDIAN MUMMY FROM CLIFF DWELLING NEAR JEROME, ARIZONA.

Inventors and the British War Office.

A letter was recently published in The London Times complaining of the British board, which inquires into military inventions, and the writer describes his experience with this board. The problem which he was endeavoring to solve was how to obtain accuracy for a dropping, or high angle rifle fire, a most important subject in view of the present conditions of modern warfare, for it is well known that in the engagements in the present war, the British troops rarely saw a Boer at all. Direct fire under these circumstances is almost useless except at very close quarters. There would be no escape from a high angle fire if it could be compassed. The experiments of the writer were in the direction of affixing a small, simple and economical apparatus to the rifle so that a man would know at what angle to hold his gun in order to drop a bullet in any given range. Having convinced himself that his invention was a good one he wished to have it examined by the War Office with a view to adoption. He therefore communicated with the War Office, briefly stating his idea and this was forwarded to the Director General of Ordnance, who replied as follows: "Sir: With reference to your letter concerning an appliance for adapting rifles to high-angle fire, I am directed by the Secretary of State for War to inform you that he will not trouble you in the matter. I am, sir, your obedient servant (Signature illegible), Director-General of Ordnance."

While the British War Office cannot be expected to concern themselves with inventions of cranks, at the same time it might be supposed that the writer of the letter who was no other than Dr. A. Conan Doyle, the well-known author, would have received some consideration. There is no more promising field at the present time for the inventor than in articles intended for the military establishment. We are pleased to know that our own Department of War has, on many occasions, given gratifying support to the inventor by ordering guns, gun carriages, etc., made and tested on a large scale, and the results have been most satisfactory, as the government now controls many important inventions.

The Transportation of Tea.

A Siberian paper published at Tomsk, gives some curious details regarding the Russian tea caravans that transport vast quantities of tea and distribute it in various parts of Siberia and Russia. During the first twenty days of January, 1899, there was an average of a thousand sleighs per day loaded with tea passing through Tomsk. The ordinary size of the tea caravans are from 50 to 70 sleighs, but it is not unusual to have from 200 to 300 sleighs in a caravan. The average load is five bales, each bale weighing about a hundred pounds. Five sleighs are fastened together and are drawn by one horse and are attended by one man. On the rear sleigh of each group is tied a bundle of hay and a measure of oats so that the next horse behind may feed during the march so that the caravan does not need to halt for the purpose of feeding the horses. The front horse is changed occasionally so as to give him an opportunity of feeding also. The caravans travel night and day and only stop at villages where the weary horses are exchanged. The drivers sleep on the sleighs while traveling. When the Trans-Siberian road is completed tea will be carried from China and distributed through Siberian and Western Russia with the same despatch as freight is handled in the United States and twelve cars will carry as much freight as a thousand sleighs drawn by two hundred horses and attended by two hundred men, the difference in the cost of the tea to the consumer and the saving in time and transportation may be readily imagined.

The Agrostological Work of the Department of Agriculture.

The division of agrostology performs important labors in the Department of Agriculture, and before describing them it is perhaps well to define the word. "Agrostology" is that branch of botany which treats of grasses. The grasses and forage plant investigations have been carried on for many years, and the value and necessity of actual field work as well as the importance of experimental cultures of the grasses and forage plants which we may wish to propagate and introduce into cultivation, are no longer questioned. Observations in the field have enabled us to understand the forage problem and needs of the several sections of the United States and materially advance our knowledge of the native grasses and forage plants, their distribution, their relative abundance, their value, before cultivation, peculiar conditions of soils and climate, and the means by which they are propagated, and their possible value to agriculture and in the economic arts. No country offers so large a number of grasses and forage plants as are to be found in the United States. There are native species adapted to nearly every condition of soil and climate and selections can be made from among them to meet almost every requirement of the farmer or the stockman. In order to secure information as to the best variety of crops to meet the needs of the various sections and climatic divisions of the country, it is necessary to study the conditions that prevail such as the soils, rainfall, drainage and temperatures which govern the development of the plants in a given area. Most of the force of the division has been sent into the field, or special agents are employed to learn by direct observation the habits and distribution of native grasses and forage plants. Experimental work has been conducted at Abilene, Texas, with excellent results and experiments with grasses and forage plants have also been made in Eastern Washington at Yakima and Walla Walla in co-operation with the Northern Pacific Railroad and the Oregon Railroad and Navigation companies.

Among the most interesting and promising varieties tested are Turkestan alfalfa from the dry regions of Western Asia, and the oasis of alfalfa from North Africa. The field experiments of the division are being largely carried on through co-operation with prominent farmers in the different parts of the country and with some of the State Experiment Stations. The investigation of the self-binding grasses has been continued and observations of the native sand-binders have been extended southwesterly along the Atlantic coast to Florida, and also at various points along the Pacific and in the sandy regions of Eastern Oregon and Washington. Some promising species of this group of grasses have been discovered specially in the Pacific coast region and experiments in propagating them have been introduced. During the past fiscal year 6,246 sheets of mounted specimens have been added to the collection of herbarium and the total number added during the past five years is 19,078. Many thousands of specimens have been submitted to the division for identification since its organization. Between 3,000 and 4,000 were determined by correspondence during the year. A number of bulletins, circulars, etc., were issued. The cultivation of grasses and forage plants on the department grounds has been continued and has been a source of attraction throughout the season. This grass garden has given opportunity to those interested to know the appearance and growth of a great number of important grasses and forage plants. During the year the division has distributed seeds of 185 varieties of grasses and forage plants. They were nearly all sent to experiment stations or to correspondents who had requested an opportunity to co-operate with the division in this work.

It is recommended that the appropriations for the division be increased, as there are constant demand for the extension of these investigations into new fields. Thus, for example, urgent demands come from the Gulf coast region where the question of raising forage upon lands whose fertility has been exhausted by long-continued cultivation of cotton, is now engaging the serious attention of Southern planters, and the holding of drifting sands about the fortifications along the coast, has been called to the attention of the division by the War Department, and it is imperative that experimental trials of known sand-binding grasses should be made in a number of localities where damage is being caused by blowing sands.

The railroads whose lines pass through sandy districts, where the driftings often seriously impede traffic, and private parties or corporations whose lands are being made desert wastes by shifting piles of sand, are demanding information which can only be offered by practical demonstration of the adaptability of certain grasses to fixing these destroying sand drifts. Inquiries concerning sand-binders have come to the division even from Japan, where the city of Niigata, on the northwest coast, is threatened with destruction by sand blowing the sea.

The Risks of Siphons.

The ordinary charging pressure for the siphon bottle is from 120 to 150 pounds to the square inch. When a bottle so charged sustains a fall of only a few feet the jar is liable to cause an explosion, and the same result may occur by exposure to heat. The Druggist's Circular recently had an excellent article upon the risks of the siphon in which a number of damage cases are cited, and it recommends that a special warning label setting forth the risks of handling siphons be placed on every bottle. The moral obligation to protect one's fellows from danger is obvious enough and pharmacists and others who sell siphons could readily force the bottler to affix such labels. The siphon should always be carried by the head. Children should be specially warned to do this because they are apt to find the bottles heavy and clasp them close to the body. Sudden changes of temperature should be avoided and the cold bottle should not be grasped with the hand. The courts seem to have always held in siphon accidents that the bottler was responsible. If there was the slightest defect in the siphon or the slightest carelessness in handling them. The driver of a wagon containing filled siphons was delivering some of them to a customer; one of the bottles fell and struck the ground where it burst into fragments, striking a man in the face permanently impairing his vision. A suit was brought against the manufacturer whose wagon was delivering the water. A verdict of $3,000 damage was obtained. The case was carried to the Appellate Division of the Supreme Court and the judgment was affirmed.

The Current Supplement.

"A Visit to the Exposition of 1900" forms the first-page article of the current Supplement, and is fully illustrated with a number of views showing the gradual transformation which has been wrought in the last few months in the Esplanade des Invalides, and other portions of the grounds. "The Pan-American Exposition" forms another interesting article and is accompanied by an engraving and a plan of the Exposition. "Is the Steering of the Modern Screw-Propelled Vessel Defective?" is by the late Captain Cornelius W. McKay. The first installment is in this issue. "The Nature of the Elements," is by Dr. Curt Schmidt, and is accompanied by descriptive engravings. "The Doctor Outside of Medicine," is the most interesting article by Dr. William L. Stowell, M.D., and treats of the subject in an exhaustive manner.

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RECENTLY PATENTED INVENTIONS.

Agricultural Implements.

PLANTING ATTACHMENT.—Samuel W Nelson, Munday, Tex. This inventor has provided a simple form of planting mechanism adapted for ready attachment to any cultivator and for operation by a ground-wheel of the cultivator. The operating devices for this planting mechanism are so constructed that the seed can be dropped at any desired interval. The device meets all the requirements of the average farmer.

Bicycle-Appliances.

BICYCLE SUPPORT.—Frederick Barry, Silverton, Colo. The bicycle-support consists of clips arranged for attachment to a bicycle frame. Rods extend from one clip to another and connect the clips. A runner has ears bent around the rods, whereby it is fitted to slide thereon. Supporting rods are pivotally secured to the runner, and links are pivotally secured to the lower clip and the supporting-rods. The device can be applied to or removed from the lower brace merely by opening the clips.

Mechanical Devices.

FOOT-POWER.—Zeb McCune, West Alexander, Penn. The foot-power mechanism is especially adapted for operating a dash-churn, although useful for other purposes. The foot-power is so constructed that a steady and continuous movement is imparted to the dasher, with little exertion. A rock-shaft mounted in a frame is provided with a bevel-pinion. In planes at right angles to the plane of the pinion are two beveled segmental racks meshing with the pinion at opposite sides. A treadle is attached to each rack, the treadles being projected downward from the racks into proximity to the plane of the frame-brace, permitting the treadles to be rocked in opposite directions to drive the rock-shaft.

SACK-TYING MACHINE.—Jesse W. Pedigo, Harrodsburg, Ind. The machine is particularly adapted for tying paper flour-sacks and comprises means for crimping and closing the mouth of the sack and securing it with knotted thread or cord. The apparatus can be used for other forms of similar work. Indeed, the principle covered by the patent extends to the work of tying packages of any sort. For tying sacks, the apparatus has a number of carriers on which the sacks are placed and which carry the sacks successively to devices for closing and temporarily holding closed the mouths of the sacks. Then the sacks are moved to the knotting devices which knot the thread around them. This done, the temporary closing devices release themselves, whereupon the bag can be taken from the machine. The apparatus is an entirely new invention in its class. The claims granted are very comprehensive.

Miscellaneous Inventions.

TIME-ALARM MECHANISM.—Charles Schmidt, 1908 Frenchmen Street, New Orleans, La. The apparatus consists of a clock-train which drives a main wheel having projectible parts arranged to operate a lever. A second lever is connected with the first lever, and a fly-wheel is arranged to be held and released by the second lever. Special alarm mechanism is provided, arranged to be operated by ordinary striking mechanism. The device is intended for use in factories, school-houses, residences, where it is desired to give signals at certain times. The mechanism is to be set in advance to secure the sounding of the alarm at this time.

COMPOSITION OF MATTER.—Captain William Prampolini, San Luis Potosi, Mex. This composition is a substitute for india-rubber, and consists of the gummy matter of the shrub called *Synantheroeas Mexicanas*, by botanists and Indians, "Yule," "Copalin," and "Jiguhite." The gummy matter is obtained by using benzine, gasoline, or other hydrocarbons. It may be vulcanized perfectly, and is better than most india-rubber, because it is free from all mechanical impurities, and needs no preliminary cracking, grinding, and washing. It is cheap, easily obtained, and saves machinery in manufacture.

PACKAGE-HANDLE.—Henry H. Flanders, Boston, Mass. The carrier comprises a trough-shaped handle having slits extending longitudinally from its ends and terminating in enlargements or apertures. A yoke having a central member extends on the upper surface of the trough between the apertures, then passes downward through the apertures, and has horizontal offsets underlying the slitted portions of the handle. Hooked end members extend downwardly from the offsets. No solder or fastening means are required to hold the yoke in position in the handle. Consequently very little labor is required in assembling the parts, thereby rendering the cost of manufacture exceedingly low.

NON-REFILLABLE BOTTLE.—William J. Earl, Salida, and Oscar B. Critchlow, Grand Junction, Colo. The bottle has a valve seated in the lower portion of the neck. A protector, seated in the upper portion of the neck, is formed of two sections with an interlocking recess and lug. The upper section has a cavity in its lower portion. The two sections have passages out of registry with each other. The protector has recesses in its side walls, which recesses register with the recesses in the neck of the bottle. Springs fit in the registering recesses to hold the protector in place.

LANTERN.—Charles H. Koster, Brooklyn, New York city. The lantern comprises a frame having an integral back and base, the base being provided with means for removably holding a lamp-chimney and an illuminating device. The lantern can be hung on the wall by hooks. A shelf extends forwardly from the top of the back over the lamp-chimney to form a wind-break or shield. This device is cheap and answers all the requirements of a more expensive lantern, when light is only temporarily required.

HARNESS.—Carl B. Olsen, Canby, Minn. The object of the invention is to provide an attachment for all kinds of harness, especially double harness, which will greatly reduce the pressure of the collar upon the neck of a horse. The collar will not move backward or forward when the horse is backing, but will remain in its proper position, thus preventing sore necks, especially since the weight of the vehicle or its pole or tongue will not be sustained by the collar.

EYEGLASSES.—Frank M. Thomson, Wilmington, Del. This invention relates to a peculiar construction of the bridges of eyeglasses, the object being to provide better means for attaching and adjusting the bridge with respect to the lenses. The bridge has each end portion bent to form two loops, the one projected upwardly and the other downwardly. The loops permit the adjustable attachment of the bridge to the lenses. The downwardly-projecting loop has its lower end constructed to bear against the nose. A plate is mounted at each end of the bridge to form additional bearing surface.

Designs.

FASTENING EYE.—E. Stewart, care of John Stewart, 71 Broadway, Manhattan, New York city. The design provides a very simple and ingenious fastening eye which can be cheaply manufactured. It is said that the eye is a most efficient device for holding the back of a shirt-waist in position, possessing an additional merit in the fact that it can be sewn permanently in place.

HORSESHOE-PAD.—Jacob Kronenberg, Brooklyn, New York city. The pad is made of rubber and is so constructed that the horse can gain a firmer foot-hold than with an iron shoe. Hygienically the pad is in every way better than the shoe.

FISH-CLEANING KNIFE.—William J. Irwin, Manhattan, New York city. The knife is a double-bladed cutting instrument intended especially for cutting out the spinal column of a fish. The blades and connecting back are formed especially for the service which the knife is to perform.

BODY-PORTION FOR BELTS.—Louis Sanders, Brooklyn, New York city. The design consists in the marginal contour of the body portion of a belt, in which the longitudinal lines of the body section are oppositely curved at the central portion of the body are continued to the ends of the section by converging the lines more or less straight. The surface ornamentation is embossed on the outer surface of the body and represents longitudinal cord structures extending from end to end of the body.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS ETC.

Cyclopedia of American Horticulture. By L. H. Bailey, assisted by Wilhelm Miller. Vol. I—A to D. New York: The Macmillan Company. 1900. Quarto. Pp. 509. Price $5.

The handsome volume before us comprises suggestions for the cultivation of horticulture, plants, descriptions of species of fruits, vegetables, flowers and ornamental plants sold in the United States and Canada, together with geographical and biographical sketches. It is to be in four volumes illustrated with over 2,000 original engravings. The author is eminently qualified for his task, being Professor of Horticulture at Cornell University, and the author of several authoritative books. The plan of work is excellent and there are a number of half-tone engravings. The majority of the illustrations are fine cuts and they serve to elucidate the text. The information given is precisely what the horticulturist and the general reader is desirous of knowing, thus for example, take the cranberry, and we find full information not only of its botany but also its cultivation, showing cranberry marshes and the gathering of the berries together with the history of the industry, its volume and the prevailing prices, together with excellent advice to those who are seeking to make a start in the industry. Many of the articles are signed. The publishers are to be congratulated upon the production of such an eminently practical book.

Die Eisenkonstruktionen der Ingenieur-Hochbauten. Ein Lehrbuch zum Gebrauche an technischen Hochschulen und in der Praxis. Von Max Foerster. II. Lieferung. Leipsic: Wilhelm Engelmann. 1900. Pp. 113 to 192, Plates II. to VI. Quarto. Price paper. $2.75.

The second installment of Foerster's "Eisenkonstruktionen der Ingenieur-Hochbauten" is devoted to a description of iron constructive parts and iron framed structures. The chapters are characterized by the same clearness of expression and explanation to which we drew attention in our notice of the first installment of the work.

Die Moderne Chemie. Eine Schilderung der chemischen Grossindustrie. Von Dr. Wilhelm Bersch. Illustrated. Parts 21 to 25. Vienna: A Hartleben. 1900. Each part 70 cents.

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Notes and Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.

Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.

Scientific American Supplements referred to may be had at the office. Price 10 cents each.

Books referred to promptly supplied on receipt of price.

Minerals sent for examination should be distinctly marked or labeled.

(7848) G. E. C. writes: On page 26 of "Hawkin's New Catechism of Electricity," an account of an experiment made in London, by Dr. Watson, is given, wherein it is stated that a current of electricity was sent through the water of the River Thames from one shore to the other without a connecting wire. Has there been much experimenting on this line, and how far have currents of electricity been sent and received thus through water? If a subteranean stream were known to exist 10, 20 or 50 miles long and electrical connections were made with both ends, could dispatches be sent and received through it? A. The return current is always sent through the earth in telegraphing to any distance, if the wires are properly grounded. We do not know any way in which a current can be sent through the earth unless there is a wire between the two points through the air also, insulated from the earth.

(7849) S. C. B. says: 1. In your issue of March 10, in the article "A Chemical Growth," I find it impossible to obtain "sodium amalgam" at the drug store. Please inform me of what parts this solution consists. A. Sodium amalgam is a compound of mercury and the metal sodium. That the amalgam is liquid would seem to indicate that the mercury is in a large excess. We do not know the proportions for making it. Care should be exercised in mixing the two substances, since heat will be evolved as they combine. 2. Please give a good definition of electricity? A. Electricity is the cause of a large number of phenomena, including shocks, sparks, heat, light, and chemical effects.

(7850) F. M. asks: Please tell me to what letter the banjo should be tuned on the mandolin to chord perfectly together? A. The strings of a banjo are tuned from lowest up to the following notes, C, G, B, D, G. These are not the names of the strings to which they are tuned.

(7851) E. C. B. asks: Does an oil lamp, with a flat wick, give more light when turned with the wick flat (broad side toward the object) or with its edge toward the object? A. An oil lamp gives nearly half as much again light in a line perpendicular to its flat side (broad side toward the object), than it does with its edge. The light is emitted by white hot solid particles of carbon in a solid state. These are opaque to light as they are when cold. Hence they cut off the light in the direction of the edge of the flame.

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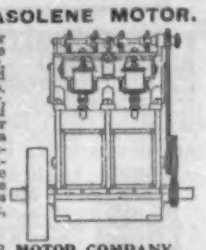

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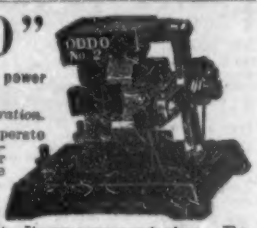

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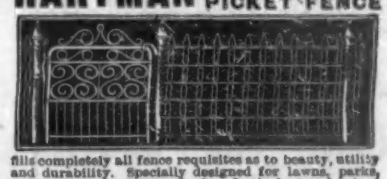

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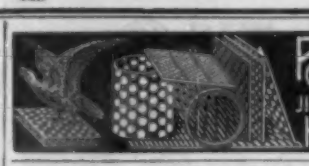

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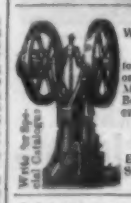

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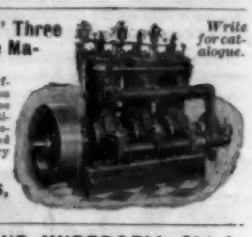

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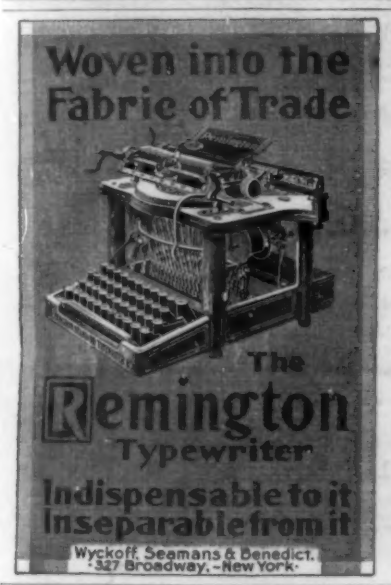

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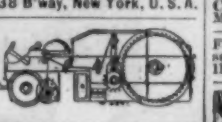

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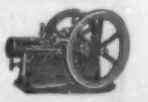

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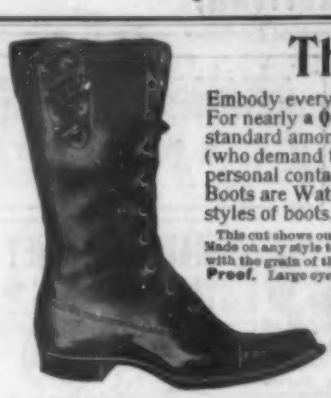

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